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Karl Wohlmuth

1. The Issues

It is our task to take stock of the Schumpeterian and Neo-Schumpeterian theories for explaining trends of global competition and especially recent trends of Asian economic development. Due to the fact that this is a wide area to analyse, we have to confine ourselves to a few aspects of Schumpeterian and Neo-Schumpeterian thinking with regard to global development and Asian development. It is timely to look at these trends as the recent Asian economic crisis reminds us of important insights of Schumpeter stating that any crisis should be considered in the context of the **theory of creative destruction** as an element of capitalist economic dynamics.

In recent discussions about causes of the Asian economic crisis we are confronted with **two major explanations**. The **first** major view of the crisis centers on financial sector problems and associated regulatory gaps, arguing that banks, enterprises and governments have interacted in a way that led to a financial crisis after a period of "bubble" economy. The **second** view on the crisis centers around the issues of the international monetary system. It is argued that the economic power, **Japan,** never succeeded in developing an international currency, so that most Asian countries remained linked to the dollar in one way or another. Monetary disturbances between the dollar and the yen then have produced distortions to the emerging regional division of labour in Asia. We know from the interwar period in Europe and America that such phenomena - as a devaluation race, growing protectionism and a widespread market instability - can cumulate especially at financial markets.

We know that even these financial/monetary explanations of the Asian crisis have indirectly to do with Schumpeterian processes in the world economy as Schumpeter constantly in his works has considered the role of credit and finance as the other important side of the innovative process and of entrepreneurial dynamics. Creative destruction is a process that reallocates credit and finance for new areas of investment, so that innovatory processes lead the changes in the financial systems. In this sense we can look at the Asian financial crisis as a process of "structural creative destruction". Schumpeterian and Neo-Schumpeterian approaches to explain the Asian crisis may then be more straightforward to explain the causes and the cure. The Asian crisis may then be interpreted in the context of long waves and cycles or clusters of innovation, but also in the context of innovative search activities and national innovative systems. More generally, "catching up" and "falling behind" processes are at the centre of the approaches we refer to in this paper. It is therefore of relevance to combine Schumpeterian and Neo-Schumpeterian wisdom with regard to innovation, global development and global competition referring to Asian development and the Asian crisis.

In **section 2** we will present selected basic definitions and basic concepts that matter when we speak about Schumpeterian and Neo-Schumpeterian competition, and we will relate the debate to global competition and development. As the Neo-Schumpeterians' purpose is to look into the "black box" left by Schumpeter, it is of interest how they try to do this. However, it is not the purpose of this introduction to draw a clear line of division between Schumpeterian, Neo-Schumpeterian and evolutionary schools of thinking.

In **section 3** we will discuss the notion and relevance of the Neo-Schumpeterian concept of a national innovation system (NIS). Such systems are core elements of any Schumpeterian renaissance, and it is of interest to analyse the NISs as important elements of a national competitive advantage and of global competition. Global competition will be interpreted in the context of competing national innovation systems; the interactions between the NISs are relevant in this context.

In **section 4** the relevance of national and regional innovative systems with regard to Asian development will be discussed. In this context the relation of Japan's NIS to other Asian NISs and to the NISs of the "triad" competitors USA and Europe become relevant. It is of importance to look at the determinants of the Asian NISs, and to see how regional development is shaped by these systems. In this context direct investments and production relocations in the region and beyond have to be discussed as they constitute locational innovations in the Schumpeterian and Neo-Schumpeterian context. Also these innovations are part of the process of creative destruction. Recent analysis of investment and technology development paths of countries may be related to this process of Schumpeterian creative destruction. The state of Asian NISs and the role of Schumpeterian locational innovations as part of regional and global innovative search of Asian enterprises may then explain some factors of the economic crisis in Asia.

In the **concluding section**, some implications for the world economic order are discussed. Far from prescriptions of neoclassical free trade paradigm, the analysis of the world economy on the basis of evolutionary and Neo-Schumpeterian approaches leads to quite different policy prescriptions with regard to the world trade, investment and technology order. In this context it is imperative to draw attention to these issues for the post-Uruguay GATT/WTO agenda under the assumptions of Neo-Schumpeterian approaches.

So far the discussion of a new agenda beyond the year 2000 in a Neo-Schumpeterian framework has not really started. It is important to do this as the neoclassical base of free trade and global efficiency models contradict largely with the framework based on evolutionary and Neo-Schumpeterian thinking.

2. Schumpeterian Competition and Global Development

2.1 Schumpeterian Competition and the Black Box

Schumpeter's view on competition is the starting point for any attempt to relate his theories to global development and global competition. It is not our task to say much about the development of Schumpeter's view of competition, but it is obvious that he did extend the Austrian School argument that competition is a process of virtuous selection. He argued that competition is "primarily a process of the creation and diffusion of new knowledge within the economic system under conditions of rivalry; a process which has important re-allocative effects and, reinterpreted with current analytical tools, presumes conditions of market failure." (Egidi 1996, p. 36).

In contrast to Hayek's view that competition is a virtuous mechanism of selection, Schumpeter's competitor is forced to undertake an extensive search for innovations. Innovative activities by small or by large enterprises, by national or by international enterprises require often costly and time-consuming search processes that have to be organised properly and have to be structured systematically. Contrary to this complexity of innovative search, Hayek argued that "it is not necessary for producers to conduct an exhaustive search for the knowledge they require, because the economic system provides signals which induce them only to seek the relevant knowledge." (Egidi 1996, p. 40).

Price signals guide the producer whereas Schumpeter's producer (and innovator) has to design actively his search strategy for new processes, products, markets and locations, including new organizational and social solutions to adjust to new technologies. The Schumpeterian producer (and innovator) in this context is either a small innovative enterprise without any relevant market entry barriers (Schumpeter Mark I) or a large national or international enterprise with endogenous invention/ innovation/imitiation processes being associated with considerable market entry barriers (Schumpeter Mark II). For both types, innovative search and appropriate environmental conditions for this search matter. Successful innovative search not only reduces costs and keeps quality and performance standards ahead, but forces other enterprises to adjust rapidly so as to follow in the innovation/imitation cycle. This process is then called "creative destruction". Schumpeter and Neo-Schumpeterians argue that it is not price competition which shapes the economy, but the specific search for new innovative solutions. This type of competition only leads to decisive cost and quality advantages and shapes the competitive position of enterprises as well as of sectors and national economies.

In contrast to the neoclassical (Walras-Barone) concept of competition that is based on a convergence of prices towards an equilibrium of supply and demand, and in contrast to Hayek's virtuous selection process as the base of competition, Schumpeterian competition is a process of creative destruction based on learning, innovation and imitation. This process is generated in order to claim temporary profits that allow survival of the enterprise and at the same time lead to a dynamic reallocation of resources.

Recent Neo-Schumpeterian publications have further developed on rival concepts of competition and have tried to fill the “black box” left in the Schumpeterian concept of competition (see Metcalfe 1998; Dopfer 1994; Magnusson 1994a, b; Kurz 1990; Freeman 1985, 1987, 1988, 1994; Freeman/Clark/Soete 1982; Dosi 1988, 1997, and many others). Others have critically evaluated the Neo-Schumpeterian and evolutionary approaches (see Heertje 1988 b, 1993). Most important, Neo-Schumpeterians clearly pointed out that the concept of competition has to be derived from the explanatory purpose of using this particular concept. “A theory which is designed to illuminate the allocation of given resources to given ends will be thoroughly different in character from one which is designed to explore the nature of economic development and the creation of resources and opportunities over time.” (Metcalfe 1998, p. 10).

It is then obvious that any analysis of global competition in the context of internationalisation, catching-up and falling behind needs to be worked out on the basis of such a dynamic and evolutionary notion of competition. However, a dynamic concept of competition involves various types of innovations in concert, as not exclusively technical innovations matter but also social, locational and organisational innovations. It is now common ground that these forms and types of innovation have to be regarded as highly interdependent, interrelated, mutually supportive and inseparable (Metcalfe 1998, p. 11).

Considering these facts it can be argued that any innovative search activity cannot be separated from the environment for innovations. In this context studies on the catching-up of countries in the ladder of world market competition, especially of Asian countries, have focussed on the “social capability” to master new technical inventions and innovations (see Abramovitz 1986, 1988). Recent analyses of economic development under evolutionary assumptions take up the close relationship of innovative search and environment for innovations (see Dosi/Freeman/Fabiani 1994). The concept of "social capability" is so central to Neo-Schumpeterian and evolutionary approaches as "institutional and human capital components of social capability develop only slowly as education and organizations respond to the requirements of technological opportunity." (Abramovitz 1988, p. 339).

Innovative search therefore depends on quality and pace of the development of NISs, as "social capability" is a direct function of the development of NISs. NIS can help to identify new technical opportunities, can facilitate diffusion and imitation, and can support Schumpeter Mark I and Mark II enterprises in their innovative search. The "stylised" facts about catching-up processes (see Dosi et al 1994) in this context identify necessary and sufficient conditions for developmental processes (see Dosi et al 1994, pp. 28-35). With reference to Asia but also to Latin America it is possible to identify these "conditioning" factors for catching-up processes. Most important is the internal creation of a basis for technical learning in an enterprise. Technological accumulation within the enterprise and competence building on the basis of these learning processes allow then to combine actively and with increasing returns external and internal sources of information. A proxy to measure this conditioning factor is the volume and share of business-financed R&D expenditures by an enterprise, a sector, and a country.

However, beside these necessary conditions for catching-up various sufficiency conditions are relevant:

- **first**, the number of qualified engineers, especially of electronic engineering;
- **second**, an adequate public and private infrastructure in education, training, information and technical services;
- **third**, learning from production and marketing by appropriate corporate organizations and other institutions in the country, especially by establishing dynamic systems of corporate governance;

- **fourth**, physical investment which incorporates new technologies, and that is thereby widely diffusing new technologies in the economic system; and
- **fifth**, a composition of physical investment that favours most dynamic investment components as telecommunication and computers.

As the internal technical and management learning process within the enterprises is the most important catching-up factor (see Dosi et al 1994, p. 31), intra-firm organisation and financing of innovations are the key competitive factors. Business-financed R&D expenditure is only a (rough) proxy for this key factor, and we know - especially also from Asian development - that other elements (technology contracts, embodied technology, licences, skills accumulation in the enterprise, and many other forms of technical learning) can substitute for a low volume of R&D expenditures. This is also an explanation of the "Krugman paradoxon" that some Asian catching-up economies have in their "growth accounting" no residual for technical progress (see Krugman 1996).

Schumpeter has in all his publications emphasized this broader view of learning, incorporating technical, social, organizational and managerial learning processes in the enterprise. This inseparability of intra-firm learning processes and the impacts beyond the enterprise is the dimension that makes creative destruction work beyond the firm, the sector, and the national economy (see Schumpeter 1946 on the process of creative destruction, in ch. 7 of his Capitalism, Socialism and Democracy). He argues about the "revolutions" that shape the economic structure by internal forces, from within an enterprise, and with effects on the whole economic system, so that creative destruction has to be considered as a sequence of revolutions (Schumpeter 1946, pp. 136-140). In his theory of innovation (see Schumpeter

1935, Ch. 2; and 1961, pp. 94-140) he analyses the innovation processes in the context of disharmonious capitalist development which then lead to uneven development paths. The concept of "revolutions" is taken up by Neo-Schumpeterians when they introduce such concepts as new technological paradigms, new techno-economic paradigms, and new technological regimes.

We have seen that at the center of Schumpeter's concept of competition is the innovative search within an enterprise. Success in this search decides about profits and survival of the enterprise/the entrepreneur, and the enterprises' success decides how a sector and a country can maintain competitive positions relative to trading partners.

Neo-Schumpeterians therefore have concentrated their work on the innovative search and technical change agenda. Schumpeter himself has inspired these studies all over the world since decades but, according to many informed authors, one cannot directly learn that much form him about innovative search and technical change (see Rothschild 1988). Schumpeter did not primarily focus on the innovation process, but more on the impacts and effects of innovations (see Heertje 1988, p. 87).

Neo-Schumpeterians then had to fill the "black box" to consider the process of technical change and innovation; *first*, the opportunities to innovate; *second*, the incentives for innovation; *third;* the capabilities inside and outside the enterprise to pursue innovation; and *fourth*, the mechanisms or organizational arrangements for innovative search (see Dosi 1997, and the earlier study by Dosi 1988 on the theory of innovative searches). Enterprises as learning organizations base their innovative activities in the context of a process of continuous learning; they learn from their own experience (by design, development, production, and from marketing); they learn from various external sources (at home and abroad; from customers, suppliers and contractors); they learn from many other independent organizations (universities and research institutions, governmental laboratories, consultants, licencors); but also many other supporting institutions are related to these learning activities (education and training institutions, further education institutions, and information services).

Internal arrangements for organising these technical and managerial learning processes and search activities are interrelated with national innovation systems. The NISs link the innovative search of an enterprise to the innovation-specific environment in a country (see the citation of Freeman by Dosi 1997, p. 1532, on these learning processes and the relevance of the NIS for the understanding of innovative search and learning processes). As within and between economic sectors the enterprises have different capabilities and propensities to search for innovations, it follows that market structure, sectoral performance, export performance, and national competitive advantages ultimately will depend on these innovative searches by specific firms, leading then to a process of selection, innovation and creative destruction.

Therefore, we observe that sectoral and national competitive performance of a country are both shaped by these four configurations of innovative search (opportunities, incentives, capabilities, and mechanisms).

Technological opportunities vary from one sector to another; for example, between science-based industries (pharmaceutical industry) and assembly-based industries (automotive and aircraft industry). Not only technical opportunities vary, but also in different firms of the same sector the perception of these opportunities may vary (depending also on the access to and the use of external and internal information). The use of information about technological opportunities in turn depends on the capabilities in the enterprise (to use the pool of cumulated knowledge) and on the incentives to innovate (which is a question of the appropriability of innovation rents).

Capabilities are related to the path of technological accumulation pursued so far in the history of an enterprise and the way this stock of knowledge is exploited internally. Incentives for innovations depend on specific appropriability conditions and options (by patents, moving ahead of competitors, secrecy) and on the extent of codifiability of knowledge created in the enterprise (and as well on the relation between tacit and public knowledge components created in the enterprise). In-house human capital formation and knowledge accumulation are largely complementary in the process of innovative search. Mechanisms of innovative search refer to the manifold arrangements that are possible in order to organize technological learning and innovation. Technological inter-firm collaboration, global commercial exploitation of technologies, direct investments, formal and informal technology contracts, and technology alliances are selected possibilities to organise innovative search.

Neo-Schumpeterians have identified a variety of these and other crucial elements of technological accumulation within the enterprise. It has been shown that innovation is path-dependent so that knowledge accumulation and technological orientation of the enterprise condition the innovative search path. Innovative search has therefore specific advantages (because of the path followed often for a long time), but is also risky as enterprises may suffer from lock-in mechanisms that may even result in loosing ground in new technologies. Innovative search is also related to sector-wide technological systems that involve suppliers, customers, contractors, the scientific community, and many governmental authorities. The pharmaceutical industry and the national health system form such a system. Innovative search also depends on the prevailing or emerging techno-economic paradigm, and the way technological regimes and technological trajectories are developed therein.

This dependence on the techno-economic paradigm is the most important element to explain competitive positions as all sectors and all technologies in an economy are affected. Many studies on the information technology (IT) paradigm (see Freeman 1985, 1987, 1988 in his studies on the fifth Kondratiev and the role of Japan) reveal that this particular characteristic of innovative search describes the whole process of creative destruction most comprehensively. In this regard, Neo-Schumpeterians have gone very far to look inside the black box of technological change and technological learning.

2.2 Creative Destruction and Global Competition

Neo-Schumpeterians have extended further their arguments on the processes of creative destruction that are linked to clusters of innovations and long waves of technological change. Most important is the distinction between **four types of dimensions of innovations** (see Freeman 1988): Innovations **firstly** can be incremental and continuous, thereby affecting over time most products and processes in many sectors; **secondly**, innovations can be of a more radical type, and these major innovations are discontinuous and need more time for diffusion, as the example of the computer industry shows; **thirdly**, innovations can cover whole technological systems with effects on many products and sectors, as the introduction of synthetic materials or recently bio–technological innovations; and **fourthly**, innovation and diffusion clusters of a type affecting all sectors massively are new techno-economic paradigms, as the microelectronics revolution.

Only the last type of innovation can be considered as Schumpeterian creative destruction as the whole economic system is affected fundamentally. Regions, countries and enterprises which are able to adjust early and more efficient to the new paradigm will then have a comparative/competitive advantage over other actors. An evolutionary perspective on global competition therefore focusses on the way of exploiting the opportunities of a new techno-economic paradigm.

Neo-Schumpeterians have discussed at length the diffusion of technologies that belong to the information technology paradigm (see Freeman 1985, 1987, 1988, 1994), and many studies on the Asian Miracle have come to the conclusion that Asia not only created the necessary and sufficient conditions for catching-up, it was successful in adopting the advantages and potentials of the new paradigm very early (see Dosi et al 1994, and most of the studies by Freeman since 1985). Japan and its neighbours are therefore not actors in a simple "flying geese" development process, but have followed more or less early the technology paths of the new paradigm in their enterprises' strategies and governmental policies. Uneven development is a consequence of the perception of the technological opportunities of the new paradigm, and the national locational policies, especially the NISs, as well as the innovating enterprises compete globally on the basis of the new paradigm. Global competition in the Neo-Schumpeterian view is a process of uneven exploitation of the opportunities of the new paradigm by enterprises and governments.

Asian development was facilitated by a more rapid transition from the energy-intensive, oil-based mass production paradigm to the information-intensive flexible production paradigm, and this transition was made possible by a combination of technical, social and institutional innovations; the successful transition is therefore not only due to technical innovations that characterised the new paradigm (see Freeman 1988, p. 60). In this context the NISs in Asian, especially in Japan, have been important to: a) promote the conditions for catching up; and b) speed up the introduction of the new paradigm at all levels in a balanced way.

The “technology fusion” between various technological areas (established and new ones) was made possible in Japan and in other Asian countries within and between industrial conglomerates, and led to a rapid diffusion of information technology in key industrial sectors and beyond in the whole economy. The „mechatronics revolution“ in Japan is often mentioned, but many other fusions were also coming forth. New technology fusions in line with telecommunication technology and biotechnology might now emerge as further opportunities. These technology fusions have speeded up the process of creative destruction, and were affecting the whole process of structural upgrading in Asia in the form of „structural creative destruction“ (see Ozawa 1996, 1992). This process was enhanced by technology imports and by inward and outward direct investment.

It is obvious that any paradigm-led economic change implies that infrastructures, social capabilities, regulations and innovation systems are adapted timely - otherwise social and economic problems will emerge soon. Early warnings based on a comparison of Japan with other countries (see Freeman 1988, pp. 62-63) refer to some crisis elements in Japan and in Asia in general due to inappropriate social and institutional adaptations to the new paradigm. Labour policies, education and training policies, as well as social policies, but mainly the fundamentals of the Japanese welfare system were mentioned as limitations - in comparison to the way a country like Sweden has handled the transition of its policies and structures to the new IT paradigm.

It is necessary to understand that Schumpeter’s principal statement is valid here, that “growth based on technical innovations was more likely a series of explosions than a gentle and incessant transformation" (Freeman 1994, p. 79). The Neo-Schumpeterians confirm Schumpeter's explanation of these "explosions" in the capitalist system. Innovations - according to Schumpeter - are highly concentrated in key sectors, are lopsided and disharmonious in the economic system. Furthermore, the diffusion process is inherently uneven in the system due to the fact that a time-lag between the introduction of technologies by pioneers and the adoption by followers exists; and finally the maturation of innovations (the exhaustion of technical opportunities and the decline of profitability of investment in these areas that results) is an important factor that is slowing growth.

These three issues - concentration of innovations, uneven diffusion, and maturation of innovations - explain cyclical growth not only in regions, but also in the world economy (Freeman 1994). The spread effects of the new paradigm are different in countries and regions, and the impact of these three factors on the economic system means that very specific crisis phenomena and cycles can emerge. The spread effects of the new paradigm depend on the prevailing structure of economies and ultimately are "embracing a whole constellation of technically and economically interrelated innovations and influencing an entire phase of economic development" (Freeman 1994, p. 87). Uneven development in the world economy over time and regions is the result of these interrelated processes.

Global competition and national competitive advantage have in this context a fundamentally different analytical base than the factor proportions or neo-technology gap theories of trade assume. The distinction between Ricardian short-term allocative efficiency and Schumpeterian long-term dynamic efficiency is therefore highlighted by Neo-Schumpeterians again and again (see Yoshitomi 1991, p. 23). It is even argued that Japan's development path can be considered as based on Schumpeterian dynamic economic policies.

However, it is also argued that the Schumpeterian approach of "created comparative advantages" based on innovative searches is not totally inconsistent with Heckscher-Ohlin theories of trade "once one acknowledges the dynamic and endogenised creation of national resource endowments through deliberate policies at both enterprise and government levels." (Yoshitomi 1991, p. 23). Additionally, it is argued that Schumpeterian dynamic efficiency "cannot be obtained by totally ignoring Ricardian comparative advantage." (Yoshitomi 1991, p. 24). Still, the textbooks on foreign trade wait to include Schumpeter and neo-Schumpeterians with their approaches.

The type of upgrading of Japan's industrial structure and its structure of imports and exports after World War II is taken by various authors as a proof of the convergence of Schumpeterian dynamic developmental efficiency and Heckscher-Ohlin static allocative efficiency (see Ozawa 1996, and especially Yoshitomi 1991). The path from unskilled labour-intensive to capital-intensive and then to research-intensive products for world markets can be interpreted on the basis of Schumpeterian economic dynamics, but also - at a given point of time - on the basis of Heckscher-Ohlin static allocation efficiency (then ignoring all enterprise-specific and industrial market structure-specific effects).

The analysis of Schumpeterian processes in the world economy (see Welfens 1989 a, b; Siebert 1991) is based on the concept of created comparative advantages, and this approach needs also an endogenisation of governmental policies and of inward and outward investment. Of central importance in this approach are the innovative searches of the increasing number of enterprises that compete globally (see Dunning 1997, Dunning/Narula 1996 a, b; Dunning 1997 refers to the „alliance capitalism" that is emerging). Dynamic competitive advantages are created by innovative searches in a globalised economic context and on the basis of national innovation systems that guide the innovative activity, but only if both systems - the internal innovation system of enterprises and the national innovation systems - are ahead with the new techno-economic paradigm.

In contrast to this concept of created dynamic comparative advantages the world economy is also affected by the artificial creation of comparative advantages, and these have nothing to do with Schumpeterian policies (see Yoshitomi 1991). Comparative advantages can be created artificially by trade and industry policies that are proposed and undertaken by bureaucracies. Bureaucratic selection is quite different from Schumpeterian selection of innovative products and processes, markets, organizations and locations. Schumpeterian trade, industry and technology policies as policies that facilitate innovative searches are therefore quite different from most of the strategic trade, industry and technology policies we discuss now.

In this context the crisis in Japan and in Asia has to be discussed. Questions arise: Is the crisis in Asia and in Japan the reflection of the creation of **artificial comparative advantages** by inappropriate strategic trade and industry policies? Some authors argue that this may be the case in specific sectors. Or has the crisis resulted as a reflection of the "**bubble economy**" and the "burst of the bubble"? Since the emergence of the bubble economy a fall in the real R&D expenditures for private enterprises in Japan (as measured by research intensities of enterprises) is observable (Watanabe 1996 has elaborated on these issues). Or is the crisis a reflection of both, inappropriate trade and industry policies *and* a fall in private enterprise research intensities during the bubble years? Artificial comparative advantages created with fiscal burdens and the stagnation/decline of real R&D expenditures of Japan's industries and also of industries in other Asian countries since the mid-1980s may then explain some elements of the crisis in Asia.

This interpretation may however contradict the empirically measured development of comparative advantages of so-called Schumpeterian industries in Japan and even in Korea and Taiwan since the 1970s. The research-intensive Schumpeterian industries (mobile Schumpeterian industries can be defined as the industries where production and R&D can be separated to some extent, whereas immobile Schumpeterian industries show a strong and systematic interrelation of production and R&D) have gained consistently in comparative advantage in Japan and in other Asian countries since the 1970s, but there might have been a turning point in the 1980s what needs to be investigated further (on the application of the concept of Schumpeterian industries see Klodt/Schmidt et al 1989, pp. 27-40). However, the problem with the concept of Schumpeterian industries is that it is limited to only one aspect of technical learning. Industries are classified according to research intensities, and we know that R&D intensity is only one element and one avenue of technical learning besides learning-by-doing, learning-by-using, technological acquisition, adaptation and transformation, direct investment, internal skills accumulation, etc. It is therefore not appropriate to follow this route of analysis.

Neo-Schumpeterians avoid following the path of neo-technological trade theories, although they quite often refer to them (see Freeman 1985, pp. 39-45), but both schools argue that technological factors are important for trade levels and structures. More recent studies on the relation between trade, innovation and technological change show again that the context of trade performance and innovation is more complicated than anticipated by neo-technological trade theories (see Hughes 1992, Archibugi/Pianta 1993, Grupp 1997). There is no simple upgrading from low to medium technologies, and from medium to high technologies in export performance, corresponding to the level of development of economies, and there is neither a strict correspondence of trade performance and trade specialization according to the level of technology a country has reached.

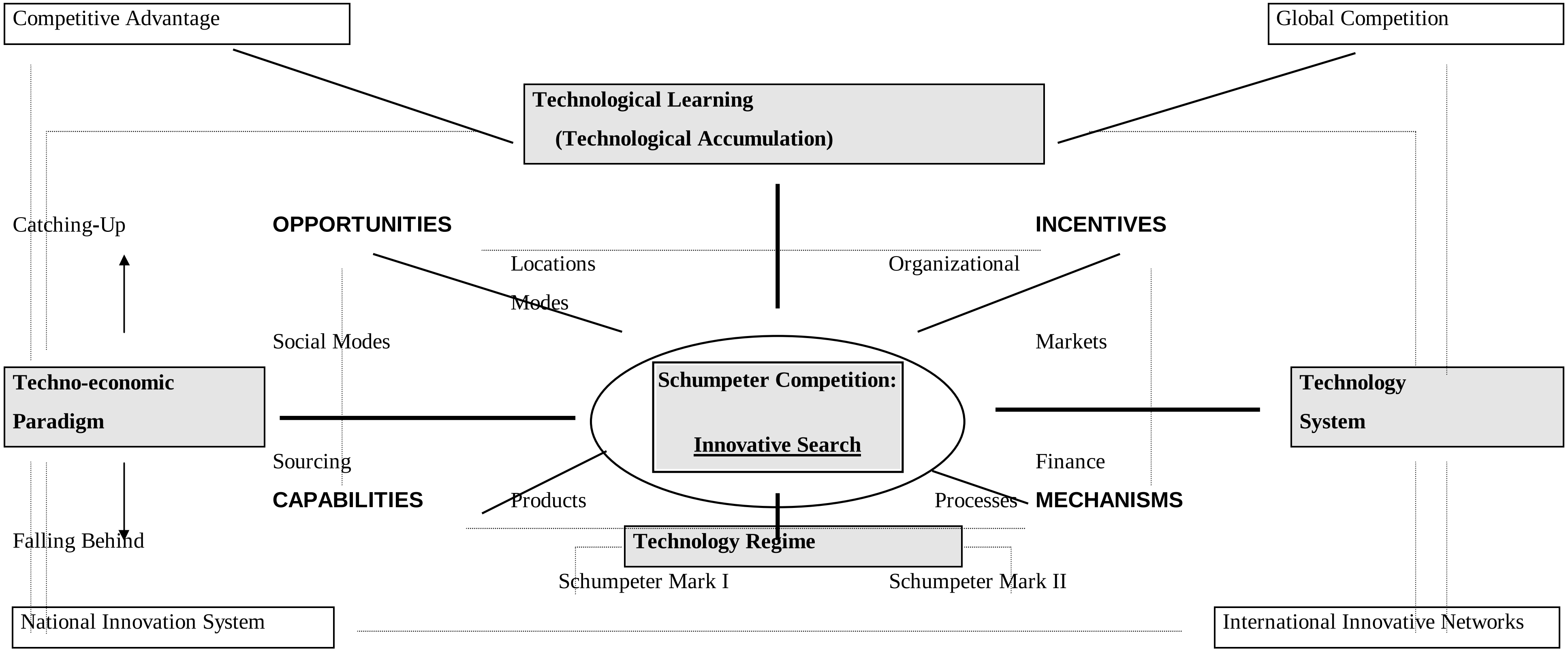
Advanced countries keep trading positions in low, medium and high technology products, although some changes in the relative position of these three groups do occur from time to time (see Hughes 1992). A Schumpeterian analysis of trade patterns incorporates however the evolving patterns of technical accumulation and performance in all sectors, and all types of technological learning that take place in low, medium and high technology sectors are considered. Sectoral technological upgrading, organizational innovations and locational innovations in low technology sectors are often as important for economies as technological upgrading innovations in medium technology industries, or exploiting new technological opportunities in high technological sectors (see Grupp 1997, pp. 257-258).

Schumpeterian analysis can much better explain the mix of traded products by technology content in the world economy, including the respective performance of enterprises in specific sectors and countries. National innovation systems can enhance technological learning processes also in low technology sectors (and especially in small enterprises in these sectors), thereby contributing to a competitive advantage at global markets. Technological, organizational and locational innovations together determine the position of low, medium and high technology goods in the global competition. Artificial creation of competitive advantages, which focusses specifically on high technology products, can be counterproductive by distorting innovative searches (in appropriately upgrading low and medium technology sectors), and by affecting negatively the dynamic reallocation of resources towards most profitable products and technologies. Neo-Schumpeterian analyses of technological accumulation in enterprises give evidence that – beside of increasing the R&D intensity - many ways of technological learning are already open, further ones can be opened, and all of these options justify the promotion of NISs. The support of NISs is the most important element of a Schumpeterian economic policy in this context. To strengthen the NISs in line with the new IT paradigm and to keep open the various ways for technological accumulation so that enterprises have more options in technical learning- these are the most relevant policy prescriptions that exist for creating competitive advantages. In this process structural changes are speeded up (see Dosi et al 1994), and a process of "structural creative destruction" (see Ozawa 1996, p. 148) sets in.

Global competitive positions and national competitive advantages are therefore related to the prevailing and emerging techno-economic paradigm. The adoption of the new paradigm has implications for all product and process innovations, for education and training systems, for corporate governance systems and the management style, for national innovation systems, and finally for the commitment of a country towards the key sectors of dynamic development (see Freeman 1985, pp. 43-45, and Dosi et al 1994). Figure 1 outlines the interrelations of forces in the context of Schumpeterian competition.

However, referring to the key role of the NISs, a more elaborate discussion in the context of globalization, global competition and national competitive advantage is needed.

Figure 1 **Schumpeter Competition and Global Development**



3. National Innovation Systems and Global Competition

3.1 National Innovation Systems and Technological Accumulation

Neo-Schumpeterians have worked intensively on the concept of a NIS to analyse the path-dependency of technological accumulation in specific countries, and to understand the role of the NIS for strengthening national competitive advantage. NISs may be understood as a "complex mixture of institutions and policies which influence the innovative process at micro-level in any particular economy". (Freeman 1994, p. 86). The concept of a NIS is close to Friedrich List's (1841) study entitled "The National System of Political Economy". According to Freeman the study of List could also be renamed "The National System of Innovation", due to the fact that List considers all relevant issues of technological accumulation, education and training, key industries promotion and trade policies, selective protection, and other issues being part of the NIS policy agenda (Freeman 1994, p. 86). The objective of List was to explain the role of a German customs union as well as of infant industries promotion, whereas Neo-Schumpeterians focus their attention on the explanation of national technological accumulation processes, especially also in Asia, to clarify the role of pro-active policies on education, R&D, technology imports, and key industry promotion (Freeman 1994, p. 86).

Neo-Schumpeterians consider NISs as "the heart of economic development", as they "determine the technological competitiveness of nations." (STI Review, 1994, no. 14, Introduction, p. 7). According to Neo-Schumpeterians global competition and national competitive advantage can no longer be analysed without reference to the NISs. We are, however, aware of the fact that any attempt to define the NISs is difficult, and so far no agreed definition has emerged, which also is a consequence of the short period of working on this concept. The concept itself is only one decade old (see Patel/Pavitt 1994 b), and various authors claim to have it introduced.

NISs may be defined as “the national institutions, their incentive structures and their competencies, that determine the rate and direction of technological learning (or the volume and composition of change-generating activities) in a country” (Patel/Pavitt 1994 b, p. 12). This definition derives from the evolutionary and Neo-Schumpeterian way of thinking about the determinants of technological accumulation, the networks being relevant for technological learning, as well as the uneven development paths with regard to technological change which are observable among countries. Recently, the concept of NIS has been further developed (see Edquist 1997 and Archibugi/Michie 1997 a), so as to understand the complexity of the concept in the process of globalising economies. The concept has also been applied to regions, e.g. the APEC countries (see Barker/Goto 1998), in order to understand the interaction of sub-regional and national systems of innovation in Asia. Additionally, the idea of an innovation system is increasingly used at sub-national regional level.

Important is the fact that differences between NISs are not only rooted in different national policies, but also in persisting patterns of technological development, in persisting structures of industry, and in persisting patterns of institutions, as well as in a specific co-evolution of institutions and technologies in particular countries (see Barker/Goto 1998, p. 254). NISs are therefore defined – inter alia - by policies, structures, institutions, networks and configurations.

NISs are characterised by many institutions in concert - education and training institutions, private and public research and science institutions; private enterprises investing in R&D, and moreover being involved in technological learning and technological accumulation; finance institutions which are active in financing innovative activities; joint ventures among enterprises and research companies; professionals' organisations setting technical standards; patent organizations; technical and data information centres; and many other public and private institutions that constitute nowadays the NISs. Incentives are important for all these organizations so that the capabilities in these institutions can be fully utilized. Incentives are also important to allow for a rapid dissemination of knowledge in the system.

Within the NIS many incentive problems and conflicts may arise. Appropriability conditions with regard to innovation rents to be captured by enterprises are sector- and size-specific; and incentive problems may arise among private actors in the training of workers, but also among public and private research institutions. Mobility of skilled labour and of researchers is important, but incentive problems in this regard have also to be considered and solved. Incentive problems also arise due to the delicate balance between innovation and imitation, so that interests have to be properly balanced out by the patent system. Public demand for innovative products is important for any diffusion of new technologies, and there can be in some cases a discrimination of small innovative enterprises with regard to public procurement policies.

Most important in NISs is therefore a balance between the interests of Schumpeter Mark I and Mark II companies. Networking and cooperation are important, but incentive problems are associated with all types of alliances and cooperations. NISs differ according to the peculiarities of cumulated knowledge, the capabilities and the competences in the system. The stock of national technological competence determines the strength and potential of NISs. Technological competence of countries differs due to uneven technological development; moreover because of the path-dependent acquisition of knowledge in the system.

Obviously, most important is the structure and the share of business-financed R&D in a system. Accumulation of technological competencies differs among and within sectors. NISs therefore have to be defined by these differences and path-dependencies. NISs may be a powerful tool in global competition if institutions in the system are adequately interlinked and open; if institutions are appropriately balanced and not conflicting each other; and finally, if competencies are accumulated and exploited in a dynamic context.

Another element of NISs is the role of specific inducement mechanisms in a country. Specific inducement mechanisms are, for example, factor scarcities, levels and structures of public investment, or specific production linkages that exist between sectors. Technological accumulation in a country is also shaped by these inducement mechanisms. They can create pressures to innovate and to disseminate new information.

The distinctiveness of NISs can be measured by appropriate indicators, as the share of business-financed R&D, the share in foreign patenting, and the sector composition of national technological activities as measured by the sector patent share of a country relative to the sector share at world level. Other indicators refer to the expenditure share for (mostly public) basic research, or to education and training levels of the workforce. Technological performance indicators (as business-financed R&D) can then be compared with science performance indicators (as expenditure shares on basic research) so as to measure the correlation between technology and science performance indicators. Although a strong correlation generally emerges, deviations from this trend may occur, and technology indicators obviously change earlier than science indicators (see Patel/Pavitt 1994 b, p. 21). This has implications for any reorientation of science and technology policies. NISs also differ with regard to the growth rates of these indicators. Differences are also important regarding the education and training levels of the workforce in countries, especially in the field of intermediate qualifications from which production and technical learning processes depend on. All indicators show a country-specific path dependency of technological accumulation (Patel/Pavitt, 1994 a, b).

Neo-Schumpeterians are therefore interested in understanding the failures with regard to NISs. There are three categories of failures according to the issues of institutions, incentives and competencies (see Patel/Pavitt 1994 b). NISs can contribute to global competitive positions and national competitive advantage if these failures of the system are identified and eliminated.

Institutional failures relate to the absence of institutions (say of venture capital institutions), to low quality and efficiency standards of institutions (say of education and training institutions or of in-house R&D in large companies), and to the desirable extent and quality of the networking of these institutions (as they can organise the exchange of knowledge based on their specific competencies). The networking deficiencies are obviously most relevant in this context, but absence and low quality standards of institutions also matter.

There may be *incentive failures* with regard to person-embodied knowledge if intensive mobility of personnel leads to underinvestment in human capital (education and training). Incentive problems can arise if insufficient intellectual property protection limits innovative activities. Furthermore, incentive problems can arise if public procurement of innovative products discriminates small firms. Finally, incentive problems may arise in the context of the appropriability of innovation rents, especially in sectors where public (codifiable) knowledge is more important than tacit (uncodifiable) knowledge (say in the pharmaceutical industry). Important is the early recognition of failures and the regulation of the system in such a way that incentives are kept adequately working.

Competency failures result from inadequate (incompetent) company governance systems; these systems are highly different in the USA, in Japan and in Europe. The national finance system, the access of innovators to capital markets, and the reaction of these markets to managerial behaviour all matter. A distinction in this context is made between “myopic” and “dynamic” NISs (see Patel/Pavitt 1994 b), as investors in myopic systems evaluate technological investments quite similar to other investments. Dynamic NISs consider the difference of technological investments (as being specialised, long-run, complex, professionalised, and path-dependent) to other investments. Dynamic systems have the characteristic of being more open towards technological competence-building. It may be doubted, however, that the NISs of Japan and Germany are still archetypical dynamic ones as opposed to the NISs of the USA and the UK, which are considered to be archetypical myopic ones (Patel/Pavitt 1994 b, p. 24).

Obviously, the internationalization of the Japanese financial system and recent changes in corporate governance in Japan had an impact - probably so far a negative one - on technological accumulation in Japan (on results see Watanabe 1996 and Goto/Odagiri 1997). And this impact may have various transmission channels (e.g., capital cost increases for research equipment; a transition to a more myopic innovation system in Japan, etc.). In the long run, more positive effects may emerge (by changing the Japanese innovation paradigm, see Imai 1990).

Inducement mechanisms are the “drivers” of the NIS, and additionally shape the competitive position of the country in the global context. From Japan we know that factor scarcities explain the change towards energy-, resource-, and environment-saving technologies, so generating new paths of resource-saving technologies. Also from Japan (and other countries) we gained knowledge that public demand for telecommunications equipment has led to a wide diffusion of this technology, resulting in a catching-up and (partly) forging ahead of the innovation system. Japan has also benefitted from technological linkages between the automotive industries, the robot industry and electronic goods industry; these linkages have enhanced the technological accumulation. Another important inducement mechanism is the cumulative mastery of core technologies and the exploitation of these core technologies on world markets, based on a situation of competitive rivalry which precluded monopolization (see Patel/Pavitt 1994 b, p. 26).

Competitive pressures from the world market in specific industries and the exploitation of technological advantages of specific industries on world markets under conditions of competitive rivalry are very important inducement mechanisms. Due to this fact the Neo-Schumpeterians are very close to Porter’s “diamond” (see Porter 1990; and on Porter the studies by Narula 1993 and Dunning 1992). We observe many similarities between Porter’s framework and the Neo-Schumpeterians, although technological accumulation is not primarily the focus of Porter. Porter and the Neo-Schumpeterians are more in line with each other than with the techno-globalists who emphasize a global pattern of technological accumulation rather than a pattern of distinct national technological accumulation paths (Dunning and others are, however, more recently arguing towards incorporating the role of national governments and national charachteristics of technological learning into their theoretical approaches; see especially Dunning 1997, pp.

271-279). The National Competitive Advantage (Porter 1990) diamond, and the Neo-Schumpeterian (Pavitt/Patel 1996) diamond are therefore quite close to each other. National competitiveness matters if path-dependent technological accumulation is taken into consideration, and NISs have a facilitating role to increase the productivity of future technological accumulation in a country.

3.2 National Innovation Systems and National Competitive Advantage

We are now ready to analyse the main indicators, factors and consequences of uneven national technological development as:

- the growth rate of core indicators of national technological accumulation;
- the extent of globalization of technological activities of multinational enterprises out of their nation base;
- the technological specialization of countries;
- the technology policy orientation of countries; and
- the degree of openness of a countries' national innovation system.

All five elements show the increasing relevance of **national** technological accumulation for national competitive advantage and for the ultimate positioning of the country regarding global competition. We cannot observe among advanced countries any trend towards a convergence of NISs, of technological development paths or of technological policies. Instead, an increasing divergence can be observed. These five characteristics are important as they give a quite complete picture of the technological learning possibilities and capabilities of a country.

Technological learning depends on national technological accumulation (measured by R&D expenditures or patent activity), on the ability of enterprises to produce technologies also abroad (in order to extend NISs to other regions), on the similarity or dissimilarity of technological specializations of countries by industrial sectors, on the type and efficiency of technology policy, and on the openness of NISs to incorporate knowledge from external sources or to disseminate knowledge to other countries.

It is our argument that these **five characteristics of a technological accumulation process** shape NISs and global competitive positions:

Firstly, concerning the growth of core indicators of technological accumulation, uneven technological development between countries can be observed if we measure the share of business-financed R&D expenditures in GDP, which clarifies that the stability of the ranking of countries with regard to the indicator is quite high (see Patel/Pavitt 1994 a, pp. 761-764). There is no trend towards convergence with regard to these shares among advanced and/or developing countries. Even a tendency towards divergence (strengthening further the innovative core in the world economy) can be ascertained. Trends in national per capita patents numbers among countries also state a high degree of stability in rankings. The number of emerging countries with relevant patent activities remains small. Only South Korea and Taiwan have entered the "club" of international innovators (measured by patent activity).

Secondly, concerning the globalization of innovative activities, we have to differentiate between global commercial exploitation of technologies, global technological cooperation, and global generation of technologies. So far, these three factors had been intermingled and not precisely separated so that diverse technological developments were lumped together (see Archibugi/Michie 1997 b). Obviously, the argument of the techno-globalists is strongest in the case of global commerical exploitation of technologies; the trend to trade and exploit technologies on global markets has increased considerably. Therefore, the trend puts increasing demand on a stringent WTO/TRIPS agenda.

Technological cooperation and collaboration across the border has also increased considerably, with similar growth rates in recent years. It is, however, argued that this expansion is partly only a substitute for industry-financed R&D (see Archibugi/Michie 1997 b, p. 191). The situation is quite different when it comes to the generation of technologies. Empirical evidence - mainly by Patel/Pavitt - verifies that multinational corporations produce only 11 per cent of their technologies (patents) abroad. This means that the overwhelming share of innovative activity takes place in the home country (see Pavitt/Patel 1996). Some countries still show an insignificant share of external technology generation (Japan), others show a high production rate of patents abroad (Canada, Sweden, the Netherlands). These countries seem to extend their NISs systematically to other countries.

Technology creation abroad is relatively large in sectors with low technology intensity, as in food industries, building materials, and the like. This means that technology adaptation to foreign markets is the basic motivation factor for innovative activities abroad. Concentration of innovative activity in the home country especially in the high technology sectors has various reasons. Positive external economies of linking R&D with the national innovation system as well as efficiency gains of concentrated and centralized R&D activities in industries with a high research intensity may explain this trend. Although these trends may change in the future (although probably not rapidly), we can state that innovative activities of large firms are "strongly influenced by their home countries' systems of innovation, and that managements of high-tech companies have legitimate reasons of efficiency for concentrating their innovation activities in their home country." (Pavitt/Patel 1996, p. 151). Similar to the insights of Porter's diamond the Pavitt/Patel diamond expounds the reasons of these facts (Pavitt/Patel 1996, p. 152).

As concerns the **third characteristic** of technological accumulation, the data about technological specialization of countries by sectors show quite different, nevertheless persisting patterns. The USA, Japan and Europe show quite different trends and patterns of technological specialization. The respective strengths and weaknesses of sectors, measured by indexes of Revealed Technological Advantages (RTAs), differ strongly (see Pavitt/Patel 1996, Patel/Pavitt 1994 a, Archibugi/Pianta 1993, Archibugi/Michie 1997). With RTAs, we measure the sectoral patent share of a country relative to the sector and share at global levels. Whereas the USA show an increasing relative strength in industries as military goods, raw materials, telecommunications, and a growing position in chemicals, Japan has an increasing strength in electronic, consumer and capital goods and in motor vehicles. Western Europe remains at a strong position regarding chemicals. More important than the assessment of the relative strength is the high degree of stability observed in these positions. This can be explained by the national path-dependence of technological accumulation. On the other hand, the degree of similarity of technological specialization among countries is quite low. National patterns of technological accumulation and national inducement factors may explain the stability of specializations and the dissimilarity of countries in technological specialization.

Non-globalized technology production, the high degree of stability of country positions and the non-similarity of technological specializations may then lead to the conclusion that national innovation policies are far from being obsolete. It may even be argued that “the dichotomy global/national is a false one.” (Archibugi/Michie 1997, p. 188). A strong national technological and innovative base allows it to cooperate with strong technological partners elsewhere; moreover to attract strong technological partners from abroad. High technological competence can attract competence from other countries, and strong competence cooperates with competence elsewhere, thereby creating a global network which enhances the national competitive advantage of these countries (see on this implication of the international technological accumulation process Cantwell 1994 a, b). Any foreign investment in R&D is then undertaken to acquire from the partner technological knowledge which by other channels can not be obtained. This hypothesis seems to be verified as evidence shows that direct foreign investment in R&D does not lead to a replication of the home countries' technological competence but to an acquirement of competence of the host country (Archibugi/Michie 1997, p. 189). These complementary R&D-oriented foreign direct investments (FDIs) may even speed up in the future, if globalization and integration processes in the world economy continue. This type of direct investment will, however, not lead to technological convergence among countries, but rather to further divergence. The statements are verified by empirical evidence showing that "the differences in the degree of technological specialisation have increased, for the majority of countries..." (Archibugi/Michie 1997, p. 189). Multinational companies are exploiting and accumulating technological strengths abroad, thereby strengthening the home countries' technological position as well as the own national innovation system. More divergence in national technological competence might be the result. Innovative search and locational innovation by multinational corporations are of crucial importance for the national technological development process.

As concerns the **fourth characteristic**, it is also the case that technology policy of nations is quite path-dependent, and that technology policies often strengthen the patterns of prior technological accumulation (see Meyer-Krahmer 1996). When comparing the rationale of technology policy with the instruments of technology policy for Japan, the USA and Germany, we can observe quite distinctive patterns. Concerning the rationale for technology policy, Japan emphasizes R&D spillovers and technology networks as well as technology diffusion, whereas Germany is concentrating on R&D infrastructure and technology diffusion. The USA focus mainly on R&D expenditures relating to public goods (security, health services, and environment), and on competition/market entry policies which have impact on R&D (so to favour Schumpeter Mark I enterprises and to create more competition between Schumpeter Mark II companies). Additionally, the instruments used in technology policy are highly distinctive (see Meyer-Krahmer 1996). Japan relies on information and technology transfer policies, moreover on MITI - type technology and development visions; Germany favours R&D - related institutional support and R&D subsidies; and the USA focus on intellectual property protection and public procurement policies for innovative products. These policies obviously support the type of technological accumulation prevailing in these countries.

As concerns the **fifth characteristic**, we observe that the degree of openness of NISs is quite different. Studies on the degree of openness (see Niosi/Bellon 1996) have attempted to measure the systemic openness by measuring various types of cross-border technology flows, according to channels as the R&D expenditures abroad undertaken by multinational companies, the flows related to international technological alliances, international technology transfers, international trade of capital goods and high technology products, and international flows of scientific and technical personnel. The results verify that large gaps regarding the openness are observable among countries; nevertheless, the trend follows an increasing degree of openness. However, different types of technology flows increase quite differently. Patents show the highest degree of globalization, whereas person-embodied know-how has got the lowest degree of openness. Openness of NISs may become a core issue of the future WTO agenda in investment and technology.

However, the tendency towards an increasing degree of openness of NISs does not mean that NISs tend to be convergent. Convergence of innovation systems may be quite limited. “The limits of convergence are given by different natural factor endowments, cumulative effects of industrial organization and specialization, different national stocks of knowledge, different national economic and political institutions.” (Niosi/Bellon 1996, p. 156).

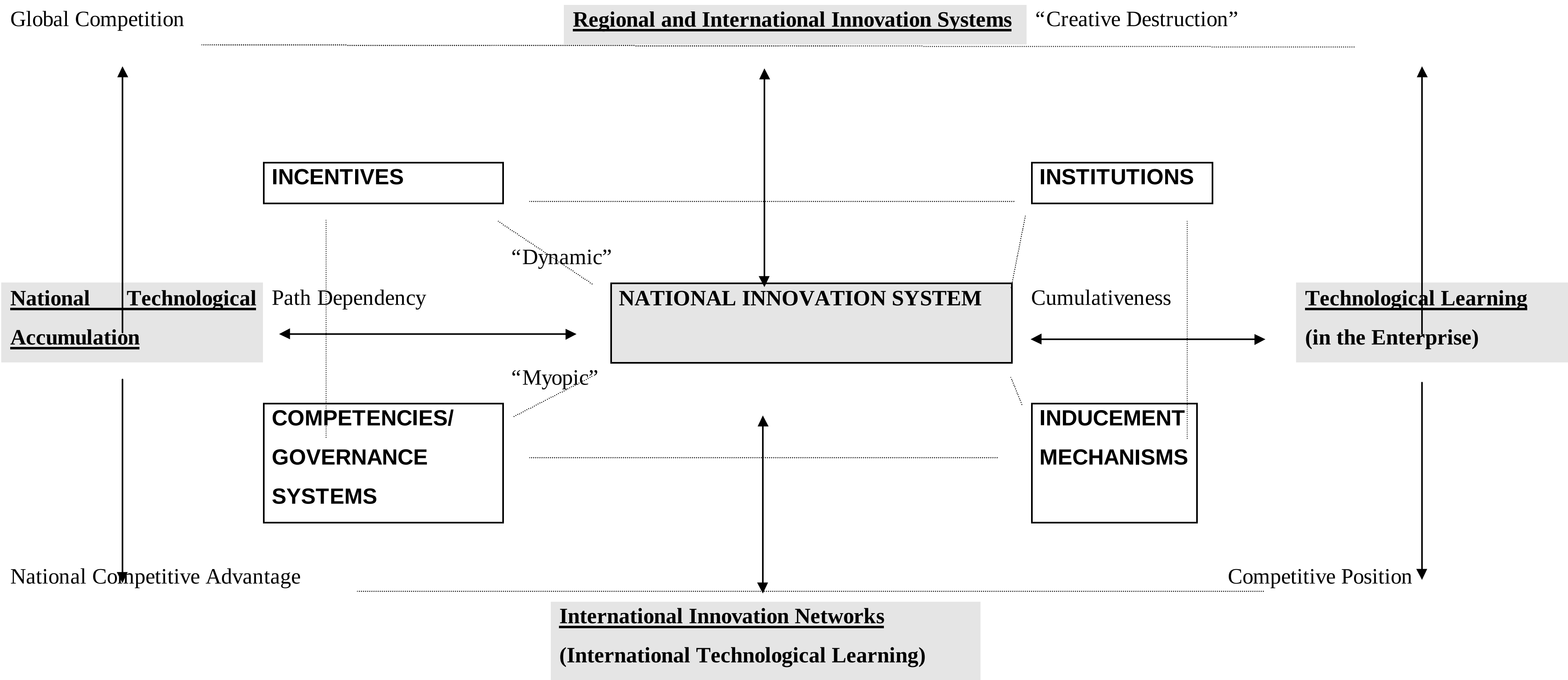
We can observe not only the trend towards an increasing degree of openness of NISs; additionally, a trend towards a creation of rudimentary regional innovation systems exists (as in the EU, APEC, and NAFTA); already visible are also international innovation systems (as TRIPS/WTO), and international innovative networks created by multinational corporations internally and when they form alliances (see on these private sector international innovation systems and networks Barré 1996, Cantwell 1992, Pearce 1992, Buckley/Casson 1992).

However, the factors discussed above show that national technological accumulation is still dominant, shapes NISs, and determines national competitive advantage. National systems of education, science policy, and management and finance reinforce such national innovation systems (see Pavitt/Patel 1996, pp. 165-167). We see strong forces of uneven technological development, and there is no observable trend towards a convergence of technological development patterns and systems.

Figure 2 highlights the main issues presented in this section.

One further important question arises: is there a difference in Asia? Can dynamic development in Asia be explained by specific national technological accumulation paths? And has the Asian economic crisis to do with the condition of national innovation systems there?

Figure 2 **National Innovation Systems and Global Competition**



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4. Asian Economic Development: A Role for National or Regional Innovation Systems?

4.1 Towards Regional Innovation Systems?

In this section, we will discuss whether national innovation systems are replaced by regional innovation systems (RISs) in Asia. Furthermore, if national innovation systems need a redirection after the Asian crisis, and after the successful catching-up phase of newly industrializing countries in Asia. Moreover, whether and, related to this question, to what extent national innovation systems are affected by inward and outward investment and increasing cross-border technology flows.

A classification of various sub-regional innovation systems had been proposed for the Asia Pacific region. National innovation systems with a European heritage (e. g. the USA, Australia, New Zealand, some Pacific island economies, etc.) exist side by side with Asian NISs as Japan and the newly industrializing countries (South Korea, Taiwan, Singapore, and Hong Kong). Thirdly, NISs of the remaining ASEAN countries, and fourthly the NISs of the PR of China and of India may be distinguished (see on this classification Barker/Goto 1998).

Although such a classification of national innovation systems is rather crude, many studies use such a categorization implicitly. However, many studies on Asian economic development and technology development emphasized clearly the distinctiveness of NISs in Asia (on the "tiger" economies see Hobday 1995). Not only the development paths of the "tiger" economies, but also the national innovation systems of these four countries are diverse. Some authors, however, see a tendency towards a regionalization of innovation systems (regarding this opinion see Barker/Goto 1998, p. 260). Obviously, increasing Asian technology flows, an increasing openness of Asian NISs, and intra-regional production networks in

Asia (based on international firms mainly from Japan and operating in hierarchical networks or alliances in various Asian countries in the same industry sector) are considered to be evidence for this trend. These tendencies are taken as a proof of a regionalization of innovation systems (updating to some extent the **flying geese model** of Akamatsu 1962). It is obvious that large increases of technology flows are observable and that these are part of the system of production networks (see Barker/Goto 1998, pp. 260-267, on recent data on Asian technology flows), and that the Asian multinational corporations play a strong role in the networks. Part of these flows is the accelerating movement of skilled people in Asia. The question is if such observations of tendencies can explain a transition from national to regional innovation systems.

RISs are now very often related to modernized and dynamized versions of the "flying geese model" which was originally only linked to trade, not to technology transfers and direct investment. In its basic version the flying geese model consists of three sub-systems; *first*, the life cycle of one industry in a specific country; *second*, the dynamic changes of industrial structures in a specific country; and *third*, the shift of industries (as a whole) from one country to another (and one industry after the other in a highly time-structured pattern). Trade exchange is linking this third (international/regional) model. It is interesting to see that for a long period of time now many authors have tried to incorporate technology transfers and direct investment as well as alliances between firms across borders into the flying geese model. Also Neo-Schumpeterians have taken up the issue by linking locational innovations to the flying geese pattern of development. The concept of "**structural creative destruction**" (see Ozawa 1996) and the concept of "**inducement innovations**" (Mucchielli/Saucier 1997) give evidence of this more recent trend to reconsider and reevaluate the flying geese model. Additionally, the interest in the concept of a national innovation system and its application to cases of Asian countries when regarding their technological accumulation paths shows the new attempt in combining the flying geese model with Neo-Schumpeterian approaches.

The identification of regional production networks in Asia (see Ravenhill 1994, Bernard/Ravenhill 1995) led to questions about the quality and the extent of linkages among Asian countries. The **minority point of view** focusses on the fact that these links are important and justify it to speak not only about a regional production system, but also about the emergence of a regional innovation system. On the other hand, the **majority point of view** focusses on the fact that in Asia independent and distinct NISs are existing and developing on the basis of specific paths of national technological accumulation (see, among others, Hobday 1995, Turpin/Spence 1996). The majority point of view is shared also by the Neo-Schumpeterian analysis of Asian economic development. Uneven technological development and quite different NISs characterize the development patterns and the competitive position of Asian countries.

Regional integration in the form of cross-border private sector production networks does not fundamentally change the situation of quite distinct NISs. Such networks (according to Ravenhill 1994, Bernard/Ravenhill 1995) are built around corporate alliances, and these corporate alliances are extended to other Asian countries in the form of links with intra-firm overseas affiliates or with affiliates of related firms, and these alliances incorporate also indigenous companies and local-foreign joint ventures (Ravenhill 1994, p. 3). However, although many of these networks are built around Japanese innovation and production models, there are many other sources of independent technological upgrading in the other Asian countries, and an independent process of technological accumulation takes place there.

The analysis of „latecomer innovations" (see Hobday 1995) emphasizes the point that the innovation patterns in Asian countries are conditioned by the national origin of catching-up process, and by the specific advantages and disadvantages of latecomer industrialization (Hobday 1995, p. 193). These conditions are highly path-dependent. Production activities of a particular industry, say electronic durables, are taking place in Asian cross-border production networks which are regionally dispersed (what some authors consider to be a time-compression of the flying geese model; see Ozawa 1996 and also the discussion in Barker/Goto 1998, p. 26). On the basis of these sector-specific cross-border production activities technological flows and innovative searches are redirected, but always on the basis of indigenous technological accumulation processes and strategies in Asian countries.

All related analyses add more evidence to the available critical evaluation of the **flying geese model** which can be described as follows:

- being too schematic, not dynamic;
- primarily explaining past developments in Asia, but excluding recent changes;
- focussing too much on Japan's foreign investment in Asia;
- ignoring the national commitment to overcome the technological dependence of Asian countries by pro-active strategies; and
- not adequately considering the role of US and European markets and other sources of trade and technology than Japan.

The sources of growth and technology are quite diversified for the Asian "latecomers", and active policies are undertaken to reduce technological dependence from Japan (see Barker/Goto 1998, p. 269). Summarising, these facts do not make the flying geese model a relevant explanation for Asian development of today.

The NISs of these countries are not a simple replication of Japan’s innovation system. The regional production networks in Asia can easily be explained on the basis of Schumpeterian locational innovations - and not only Japanese companies are in an innovative search for capturing temporary profits from relocation. A functioning NIS, however, stimulates and guides locational innovations and is therefore actively shaping the national technological accumulation processes. Regional production networks are not only compatible with a strong position of NISs, but even benefit from an increased strength of these systems by creating new and profitable relocation possibilities.

Recent growth accounting for Asian countries, based on the work of Krugman (1996) and various others (see Khan 1998 on this important discussion), has led to the result that only a small or negligible role for the “residual ” technical progress exists. Therefore, some authors ask why there should have been an Asian Miracle including high total factor productivity growth rates (see World Bank 1993, pp. 46-59). Studies about the four tiger economies come to the conclusion that capital, labour and human capital account for 64.25 per cent, 18.25 per cent and 17.5 per cent so that nothing is left for the residual “technical progress” (see Khan 1998, p. 56). Recalculating these results under the assumption of “embodied” technological progress, and conducting many other studies to measure the total factor productivity growth in Asia did not basically change the results of Krugman. All this seems to be in contradiction to the catching-up thesis which focusses on technical innovations (business-financed R&D and other forms of technical learning).

Various explanations have been given for this result: measurement and data problems; the importance of economies of scale rather than technical progress; the existence of an economic structure where certain sectors experience rapid technical progress, whereas other sectors become more inefficient (see Khan 1998, pp. 58-59). Another very important explanation is based on the assumption of strategic complementarities in the growth process. Up to now the catching-up countries benefitted from a strong complementarity between augmentation of physical and human capital. Nowadays, the time has come for a transition towards a strategic complementarity between human capital investments (by workers) and R&D investments (especially in enterprises). Whereas in the former growth model (accumulation-driven) other types of technical learning (as learning-by-doing and using, technology contracts, embodied forms of technological progress) are relevant and may explain the low level of "measured" technical progress, in the future growth model (innovation-driven) the transition to the new strategic complementarity will be crucial, and then - in later calculations - may show a larger level of "measured" technical progress in growth accounting (see Khan 1998, pp. 18-20).

When this transition is not facilitated by a dynamic NIS, a high possibility exists that instead of a high growth/high quality equilibrium a low growth/low quality equilibrium will emerge and stabilize in Asian Countries, especially if workers (as investors in human capital) and entrepreneurs (as investors in R&D) have negative expectations about the behaviour of the other side (see Khan 1998). It may then be argued that the Asian crisis to a certain extent is related to this complex transition process. When looking at some Asian countries now, we see that just this development can occur.

We can argue that Asian NISs did perform well in the catching-up process and with regard to the incorporation of the new techno-economic paradigm of microelectronics, but now the transition from a catching-up NIS to a frontrunner NIS will be the task ahead; this not only for Japan but also for South Korea, Taiwan and later for other Asian countries. The redirection of the NISs to adapt to new inducement mechanisms (rising wages, demand changes, the necessity of an increased competition between large conglomerates, the necessity of support for small innovative enterprises, pressures from regional production integration, capital cost increases, the necessity of speeding up enterprise-specific R&D) and to generate primary innovations (that are led by basic research and by technology-intensive and innovative enterprises) at a sufficient scale is the task ahead. The Asian NISs are so far related to successful catching-up innovations, resulting from large international technology transfers and their absorption in Asian countries.

It might be the case that regional technology institutions may be helpful in the process of redirecting the NISs. Some rudimentary regional innovation systems and networks - as the ASEAN's Committee on Science and Technology, the Science and Technology Task Force of the Pacific Economic Cooperation Council (PECC), and APEC's Working Group on Industrial Science and Technology (WGIST) - give opportunities to strengthen NISs and to open them up (see also Turpin/Spence 1996 on the potentials of APEC regional cooperation in science and technology). It will also be necessary to incorporate international innovative networks of multinational corporations into these systems (based on direct investment, technology cooperation and technological alliances).

4.2 Redirection of Asian National Innovation Systems and Schumpeterian Competition

The comparative analysis of Asian NISs (as, for example, by Nelson 1993) has already shown that in Asia highly distinct national innovation systems exist, but that they need to be redirected urgently. A closer look at the NISs of the Miracle Countries South Korea and Taiwan points out that the performance of the system was quite satisfactorily for a long period of time, although many problems emerged quite early. In South Korea, the NIS could not keep pace in redirection with the rapid process of structural change. Other problems were the dominance of industrial conglomerates with rather limited innovative capability, the lack of Schumpeter Mark I companies, and the import dependence of Korean industries due to the lack of supporting industries (which precluded the creation of sector-specific technology systems with local suppliers and customers). Problems with the quality and redirection of the university system also have to be mentioned (see Kim 1993). Additionally, the list of problems with regard to other system characteristics is long (to mention only problems with educational and vocational training policy, and strategic industry and technology policies). However, there are signs that South Korea may be on the way to a new innovation system, what we learn from micro-level and sector-level studies as well as from firm-specific evaluations (see Khan 1998, pp. 54-73).

Moreover, the list of system failures with regard to the NIS of Taiwan is long. The education/vocational training systems need to be revised urgently as they do not respond to the changing demand of skills; small and medium enterprises lack sufficient incentives to innovate; public companies are largely inefficient and lack innovative capabilities; and the production relocation to the PR China is often undertaken at the expense of internal industrial technological development and productivity upgrading (see Hou/Gee 1993). Regarding the Neo-Schumpeterian analyses this argument means that locational innovations are undertaken because other innovations are hindered (process and product innovations as well as organizational and social innovations). Also for Taiwan we can observe difficulties of the NIS to adapt rapidly enough to socioeconomic changes; especially there is a lack of decisive steps to move ahead from the catching-up system to a frontrunner-system.

Most important, however, is the transition process in Japan. The situation there seems to be basically different as the Japanese innovation system is a dualistic one. The innovation system covers only a share of industry, and this system may be characterized as **Schumpeter Mark Japanese (Mark J)**. This innovation system is based on:

a) the creation of resources by innovating enterprises (rather than focussing on the allocation of resources only);
b) the accumulation of technical competence in enterprises by coordinating R&D with industrial design, production and marketing;
c) the processes of interactive technical learning in the whole system of cooperating organizations (thereby creating dynamically human and capital resources); and
d) the behaviour of „group entrepreneurship", comprising various innovating firms and agencies as large and small firms, government and research organizations as well as finance institutions that are all considered to be a part of the group entrepreneurship system (see Imai/Yamazaki 1994 on this system).

Resource creation, interactive learning, group entrepreneurship, and a non-linear and integrated innovation process are part of the system; information and knowledge diffusion takes place throughout and also beyond the network, which is coordinated and integrated by the Japanese conglomerates.

The Schumpeterian notion and concept of industrial organization is here changed. In this Neo-Schumpeterian concept large conglomerates are coordinators of complementary production and R&D activities for a whole system comprising also small and medium enterprises, customers and suppliers, subcontractors, finance institutions, and even related governmental institutions (in research, training, planning). In this way the role of Mark J companies is it to combine the advantages of **Schumpeter Mark I**

and of Mark II companies. Advantages of Mark I companies (access to and absorption of new external knowledge under conditions of low market entry barriers) and advantages of Mark II companies (endogenous invention/innovation/imitation/diffusion cycles under conditions of high market entry barriers) may be combined. This might be a great advantage as we know from Schumpeterian analysis about the importance of a complementarity of Mark I and Mark II innovative activity for the NISs (see Malerba/Orsenigo 1997, Symeonidis 1996, Geroski 1995, Preuße 1993).

Especially Mark J systems may then be successful in combining incremental and radical innovations (see Imai/Yamazaki 1994, pp. 218-219). There are however doubts that the system works in this way (Imai 1990). Based on this particular Japanese innovation system, the effect on competition of Mark J companies and business groups may be important. Group entrepreneurs then would compete on world markets by collective innovative search. However, the changes in the financial system in Japan and elsewhere in Asia obviously have had implications for the Mark J system, as so far the "main bank" was of crucial importance for financing capital costs, working capital, and especially the innovations. The Mark J system might have to change also from this point of view, as the capital cost advantages Japan enjoyed in former years relative to world market competitors are now eroding. Mark J companies have so far linked and coordinated enterprises of various sizes, relevant government and research institutions, consultancy and finance institutions, as well as the related customers and suppliers in order to build a complex national (and recently international) innovation network.

For years, this system has contributed to dynamic competition and to national competitive advantages. However, this system applies only to some key strategic sectors in Japan (electronic durables, machinery and transport equipment). Other industries (chemical and software industry) have got other determinants of innovativeness due to the dependence on the particular patent system and problems with the availability of skilled labour. Domestic industries and service sectors in Japan are not part at all of a dynamic innovation system. For these sectors a vicious, not a virtuous cycle, seems to prevail (Imai/Yamazaki 1994, pp. 247-248). As these latter sectors are outside the forces of Schumpeterian dynamic competition, the complete NIS is negatively affected by this kind of dualism of efficient and rather inefficient sectors.

Therefore, we may argue that the NIS in Japan needs to be revised completely. Globalization and deregulation have impacts on the dual structure, and the efficient as well as the inefficient sectors are affected by recent tendencies that are leading to an additional strain in the system. It is argued (see Fransman 1997) that Japan's technology policy had been adapted rather smoothly to the changes of globalization, and that especially the MITI has successfully rearranged R&D programmes towards a frontrunner perspective, but it might be that MITI focusses its attention primarily on key strategic sectors (being important for the world markets), disregarding other sectors (although they are relevant in the context of the NIS). MITI's story of success may be related to the small group of Mark J industries and conglomerates, and their conditions may alter following changes regarding the financial system.

The movement towards a frontrunner system in Japan is therefore very urgent (see also Goto/Odagiri 1997). The catching-up system has worked from the 1960s to the 1980s, but since the mid-1980s many advantages of the old system were disappearing quickly (see Goto 1997; Watanabe 1996). R&D expenditures, especially the private shares, are declining, mainly when calculated in real terms; investment in plant equipment with a high embodied technology component has decreased; the cost of capital advantage is disappearing due to changes in the financial sector; and the factor of high wage costs may influence the innovative system also negatively, especially when existing local technological networks are eroded by relocation. As the lifetime employment system rapidly changes, the established system of skill formation in enterprises is endangered and needs to be substituted. All mentioned negative tendencies require reactions and a reorientation of the system.

Therefore, three very important changes of Japanese NISs are proposed (see Goto 1997, pp. 10-11):

- strengthening of the basic research system;
- changing the patent system in order to encourage radical innovations; and
- promotion of small innovative firms.

However, exactly these reforms are extremely difficult to undertake. **Interest group politics** plays a role in hampering the strengthening of the basic research base (Goto 1997). Changes with regard to small innovative firms seem also to be very difficult to realize, although they are of crucial importance for the emergence of radical new innovations because small firms are highly effective in absorbing know-how and information from outside the enterprise (see also Simonetti 1996). Small firms are stronger in using and exploiting knowledge from outside the firms, whereas larger companies are more efficient in generating knowledge internally and exploiting technologies commercially on world markets.

As the venture capital market in Japan is still undeveloped, the financial base for small high technology companies is weak. The market for skilled labour and researchers is also imperfect, as large companies have better access to talented labour. Skill gaps and financial gaps therefore hinder the development of small innovative firms. The diffusion-oriented patent system in Japan is also discriminating small firms, as they lack other means of intellectual property protection (as first-mover advantages; complementary assets; secrecy strategies; and tacit knowledge accumulation).

Another important element of a redirection of Japan's NIS is the necessity to further open the system. There is a tendency to open the system in both ways, but many transitional problems emerge in this process. Analyses of Japan's direct investment in research facilities abroad show that these investments are potentially important vehicles for information-gathering, technical accumulation and adaptation in production abroad, adaptation of products to local markets abroad, and even for advancing applied and basic research; nevertheless many management and communication problems exist (see Odagiri/Yasuda 1997; see also Morris 1991 a, b). Problems are mainly that R&D by Japanese affiliates in other countries is not closely enough related to marketing, production, and the research & development organization in the home country; and research facilities abroad are not integrated in the Mark J system. Difficulties in management and recruitment as well as communication problems emerge overseas. Failures regarding linkages, networks and communication limit the role of overseas R&D in strengthening the enterprise innovation system and in redirecting the NIS in Japan towards a frontrunner system. Even for key strategic industries international innovative links have to be strengthened.

We reach the point of stating that the Asian NISs are quite distinctive, although they share some common characteristics regarding their catching-up orientation and in focussing on the new techno-economic paradigm quite early. Any redirection of NISs has to have a country-specific starting point, and the ability to redirect will be a very important competitive factor in the context of Schumpeterian competition on world markets. The redirection of NISs is an essential requirement to keep up the competitive position of Asian countries based on the co-evolution of catching-up factors and paradigmatic factors of change.

Evidence based on the introduction of the (new) techno-economic paradigm by national strategic policies on information technology in Asia verifies that quite distinctive national strategies on the development of information technology were designed, implemented, sustained and flexibly adapted to the original starting conditions, and prevailing industry structures as well as available public and privat institutions (see the survey by Hanna/Boyson/Gunaratne 1996). Furthermore, evidence points out that remarkably different systems were developed, sharing as a common element only a consensual strategic management approach (based on: visions; outward orientation; building core competencies; promoting strategy planning and learning at all levels; and coordinating public and private efforts). Schumpeterian competition was definitely enhanced by national information technology (IT) strategies. We also have to bear in mind that the state in Asian countries had a quite different role to play in each country towards IT promotion. The state had the character of being a coach and coordinator for the private industry in Japan, a creator of private conglomerates in Korea, an incubator and supporter of small enterprises in Taiwan, an integrator and strategist in Singapore, and a provider of infrastructure in Hong Kong (Hanna/Boyson/Gunaratne 1996, p. 195). However, it may be argued critically that the innovative network was highly structured by state interventionism, and that private and non-governmental actors have to become more active from now.

In conclusion, any discussion about Asian production or innovation systems is based on misguided generalizations. Contrary to assumptions of the early flying geese model, a picture of an extended diversity of innovation strategies emerges, especially with regard to industry and technology structures, sources of technology accumulation, and development conditions of particular NISs.

Additionally, we cannot observe any convergence of technological accumulation paths and innovation systems, rather a tendency towards more diverse structures and systems. The move of Asian countries to diversify from Japanese technology dependence is another element that may further strengthen national innovation systems. It is also argued that, “as research and development becomes increasingly more nonlinear, abandoning production of certain mature products carries the risk of losing know-how in manufacturing techniques or component manufacturing that might have been critical to seemingly non-related future production.” (Bernard/Ravenhill 1995, p. 207). This means that the technological base for a flying geese relocation pattern in Asia is loosing in importance. National industrial and technological policies keep momentum in the process of structural change.

A further element of the development of NISs in Asian countries is therefore not only the tendency to overcome technological dependency from Japan, but also to avoid any extreme specialization and production dependency on the basis of a chain of products and components developed and maturing in Japan. In this context a closer look at relocation and direct investment issues is necessary, as locational innovations are of increasing relevance in the innovative search of Schumpeterian enterprises.

4.3 International Technological Learning and Schumpeterian Competition

Relocation in a Neo-Schumpeterian approach is not only the search for appropriate new geographic locations, but basically a process to augment the capital stock by freeing capital in the home country for other purposes of production (**creative destruction by relocation**). Creative destruction by relocation is not only an important element of structural change, but is also necessary for avoiding capital scarcity and resource-scarcity in general.

Impediments to relocate may also block other important innovative activities. As “capital” for Schumpeter and the Neo-Schumpeterians is not a “stock”, but the dynamic result of innovative search, locational innovations are then an integral part of the process of innovation, of capital accumulation and of resource creation (also including human resource creation). Relocation across the border is “a genuine Schumpeterian innovation, it is the result of competition and can only be stopped by interfering with the market mechanisms” (Mucchielli/Saucier 1997, p. 29).

Also locational innovations are associated with temporary profits in the Schumpeterian sense, and these profits are eroded by other innovators and imitators, by domestic as well as by international competitors. Other innovators and imitators follow this locational choice, or develop other locational alternatives. Locational innovations are especially affected by imitators. “Being innovations, relocations have impacts which are not fundamentally different from the impact of technical progress or any other kind of Schumpeterian innovation” (Mucchielli/Saucier 1997, p. 29).

Neo-Schumpeterian analyses only lead to broad guidelines with regard to causes, directions and choices of relocation/direct investment. However, it is convincingly argued that any interruption of innovations, also of locational innovations, will affect the complete innovation system and the innovative search process.

In this context three types of innovations are distinguished**: primary, inducement and catching-up innovations** (see Mucchielli/Saucier 1997). Primary innovations are based on R&D expenditures and on basic research activities. Inducement innovations result from specific inducement factors as factor scarcities, changes in demand, public investments in innovative products, or the changing attractivity of locations in the world economy. Catching-up innovations comprise diffusion processes through international imitation and diffusion of primary innovations. Catching-up innovations by imitation and diffusion are the easiest to undertake (this type of innovation is mostly identified with the "flying geese" pattern), however it is not necessarily the most efficient type of innovation. Appropriate industrial and technology policies (and other catching-up strategies) matter here. More difficult to achieve are inducement and primary innovations. The frontrunner NISs and the NISs moving from catching-up to frontrunner systems have to be strengthened in these two areas of innovations.

The crisis of Asian NISs may be related to the difficult transition process to these two other areas of innovation. Locational innovations are important for both inducement and primary innovations, as they are induced by various home and abroad factors, whilst in various locations different and in some cases complementary conditions for primary innovations exist. If locational innovations are hindered, this may have repercussions on the complete innovation system (see Mucchielli/Saucier 1997, p. 31). Dynamic innovation systems focus therefore more and more on locational innovations. This matter is also reflected in the new WTO agenda on technology and investment (see OECD, 1991, 1996 a, b; Shahin 1997, Ramaiah 1997, Messing 1997, Tüselmann 1997, Kline/Ludema 1997, Ganesan 1997).

Various studies have brought to attention the context between economic development, industrial upgrading, technological accumulation, and technological learning across the border. The investment development path (see Dunning/Narula 1996) and the technological development path (adapted to Japan's conditions by Ozawa 1996) add the important perspective of a cross-border technological learning curve which follows the path of economic development and a country's industrial upgrading process. These curves describe the changing position of inward and outward investment stock and of technology absorption/ dissemination during the process of economic development and industrial upgrading. These models present the context of a process of structural creative destruction in open economies. In some way, it is also possible to argue that these learning curves are "time-compressed" versions of the flying geese model.

According to Ozawa (1996), it is possible to identify four phases of industrial upgrading for Japan:

- labour-driven industrialization;
- heavy and chemical industrialization;
- assembly-based manufacturing; and
- innovation-driven flexible manufacturing.

The four phases of industrial upgrading overlap and additionally, four phases of overseas investment correspond to the upgrading process:

- low wage-labour seeking investment;
- resource-seeking and "house cleaning" investment;
- assembly-transplanting investment; and
- strategically networking and alliance-seeking investment.

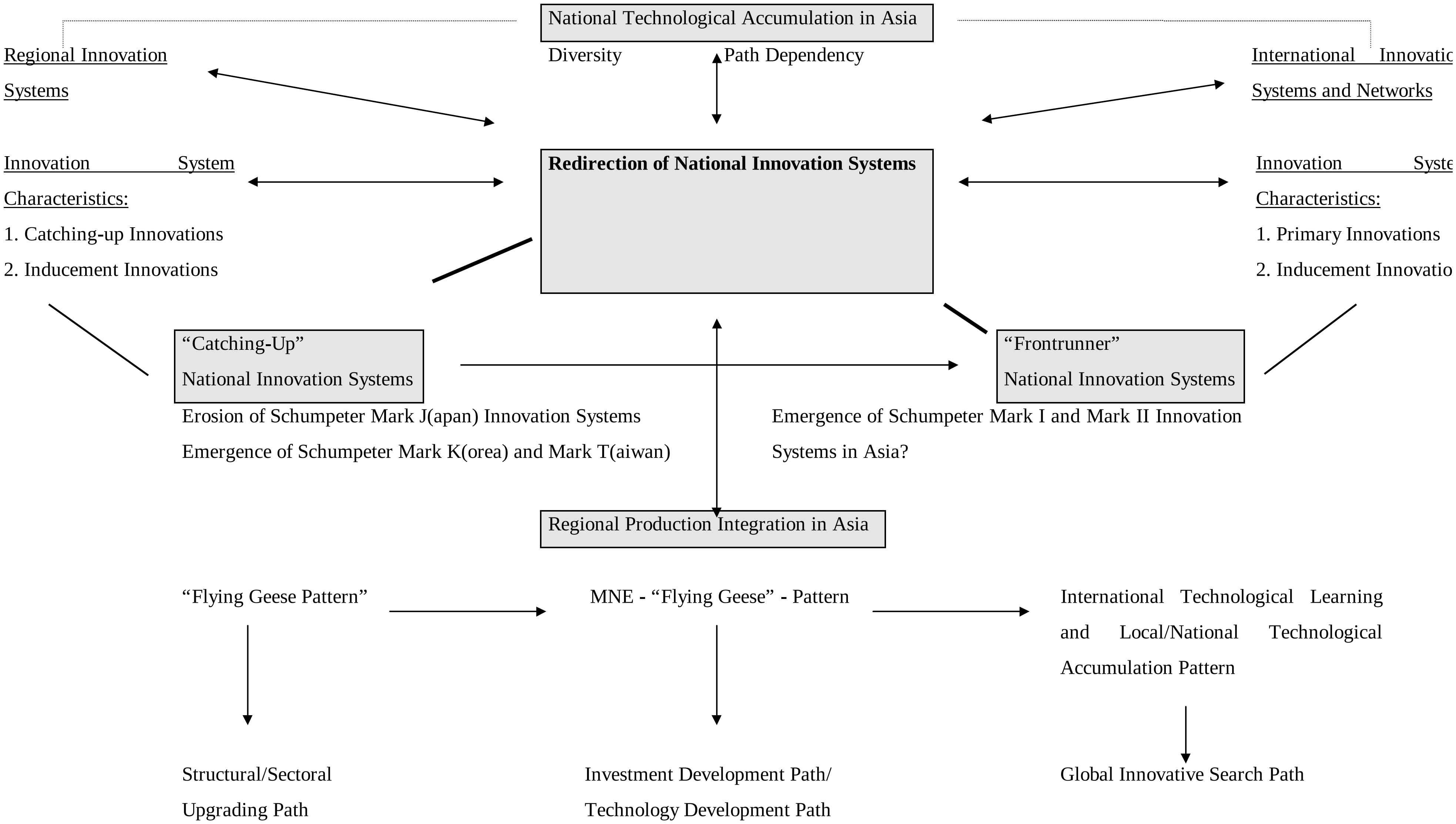
Refering to the investment/technological development path (IDP/TDP) locational innovations are an inherent element of the upgrading process, and any interference of inward/outward investment may endanger the complete process of structural creative destruction. Although the Japanese curve is different from those of other countries due to the important role of technology contracts in the technology acquisition/inward investment phase, the technological learning curve has a distinctive but similar shape (S-shape), reflecting technology acquisition and technology dissemination conducted by Japan.

Technological accumulation in the country and technological learning across the border are therefore highly associated processes conditioning each other. Any NIS has to be opened up to a certain degree in order to not impede locational innovations (the degree of openness has to be appropriate to the level of development). The Asian cases (technological learning curves/investment paths) discussed (see Dunning/ Narula 1996) show the distinctiveness of the curves depending on development policies, technological policies, and international investment and technology absorption/dissemination regimes the particular country has followed.

Redirection of Asian NISs is therefore highly dependent on the stage identified (during stages 1 - 3 the net outward investment stock position is negative, in stage 4 becomes positive, while in stage 5 the position balances out). This also means that any redirection of NISs is associated with a certain degree of openness in order to allow enterprises to make necessary locational choices: inward - and outward - bound. The technological learning curve is at the same time shaped by governmental policies (see on a frame for Schumpeterian economic policies Hanusch/Canter 1997) and by the quality of the NISs, besides reflecting the tendency of temporary profits to be eroded by innovators and imitators in open economies.

Figure 3 gives a synopsis of the discussion in this section 4.

Figure 3 **Asian Economic Development and Redirection of National Innovation Systems**



5. Concluding Remarks

We have discussed Neo-Schumpeterian positions on innovative search in enterprises and the role of national innovation systems in order to analyse the global competition between dynamic enterprises; furthermore the role of national innovation systems as determinants of national competitive advantage, and of global competition was emphasized. With regard to **Asian economic development**, it has been argued that quite distinctive national innovation systems have been developed on the basis of national technological accumulation processes, and they seem to develop further along these lines despite of production networks which integrate production in particular industrial sectors coordinated by multinational enterprises across the border of Asian countries.

The determining role of national innovation systems regarding national competitive advantage and Schumpeterian global competition has been discussed. It has been emphasized that not only the national technological accumulation paths are distinctive, but also the cross-border technological learning curves differ considerably from country to country. Therefore, national innovation systems have to be adapted to these structures, processes, and paths, and now need to be redirected from catching-up systems (based on the new techno-economic paradigm) towards frontrunner systems, especially in **Japan**, **South Korea** and **Taiwan**. Myths about the "flying geese" pattern of Asian development not only ignore the quite diverse technological accumulation and industrial upgrading processes in Asia. Additionally, they do not adequately consider the increasing relevance of national innovation systems for national competitive advantage.

The more recent interest of Neo-Schumpeterians in locational innovations reminds us that future discussions about post-

Uruguay negotiations on trade, investment and technology transfer may have to reflect more on insights from evolutionary and Neo-Schumpeterian thinking, as practically all discussions about the future of the world economic order were based so far exclusively on the neoclassical free-trade paradigm. We lack a wider perspective on WTO/GATT/TRIPS/TRIMS/GATS issues, and on the Multilateral Framework for Investment (MFI) and the Multilateral Agreement on Investment (MAI) agenda; such a wider perspective towards international negotiations may especially incorporate the specific characteristics of innovative search and technological accumulation. In this context a further extended (but somehow controlled) opening of national innovation systems might be an important task for future WTO/TRIPS and MAI/MFI negotiations. An important point of evolutionary and Neo-Schumpeterian thinking is the system approach and the network perspective, which both have to be preserved and activated in a global development and efficiency perspective.

Anyway, we are able to remark that Neo-Schumpeterians just have started to look at the world economy and on globalization/internationalization/integration issues. In this context the finance systems as the second side of Schumpeterian innovation processes become important in further analyses. New frameworks for international financial markets and for global corporate governance are required, as well as a global competition policy that deals also with Schumpeterian dynamic competition appropriately. The task is to adequately combine international finance system regulations with the exploitation of potentials of Schumpeterian competition at a global level.

We began the discussion with the question whether the Asian crisis has to do with financial, monetary or real economy/innovation system factors. We are able to reply that at least partially the Asian crisis has to do with the lag of reaction of national innovation systems to the pace of socioeconomic changes that took place in Asia, and also with the inadequate links of the national innovation systems to the national financial systems. Especially the lack of venture capital for small innovative firms, and of finance for radical innovations and for basic research has to be mentioned.

Implications of this analysis are not limited to Asian countries exclusively. On the contrary, it is not that easy for other advanced economic regions to preserve the position as a frontrunner regarding national innovation systems without steady reforms. Finance and management systems are of crucial importance in all advanced countries to keep ahead with their innovation systems. To keep these systems effective and open is an important element of technological policies related to the task of strengthening national competitive advantage in a world of intensified market competition.

On the other hand it is not easy to escape the low growth/low quality position in other economic regions (what we observe especially in Africa), if national innovation systems are not developed from the ground and are not increasingly guiding the processes of technological accumulation.

At world development level, the central message of this contribution on Schumpeterian competition and Neo-Schumpeterian approaches on global competition is that national technological accumulation matters and is further enhanced by increasing technological opportunities, an increasing competition of national innovation systems, and a growing number of enterprises involved in international innovative search.

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