

Aalborg May 2015

**The origins of the national innovation system concept and its usefulness  
in the era of the globalizing economy**

Paper prepared for presentation at the 13th Globelics Conference 2015 in Havana September 23-26

Bengt-Åke Lundvall  
bal@business.aau.dk  
Department of Business and Management  
Aalborg University

## **Abstract**

The term innovation system has become widely used by scholars from different disciplines and by policy makers from all parts of the world. This paper presents the national innovation system as a ‘new combination’ that has evolved and been reinvented by connecting it to new fields of theory and empirical research by scholars operating in disparate fields of enquiry. We start by referring to the very first contributions that made use of the concept – Freeman (1982) who emphasized the link between innovation and international trade and Lundvall (1985) who emphasized network formation and interactive learning at the national level. We use these quite disparate, but complementary, contributions to discuss some of the future paths of evolution of the concept. At the end of the paper we relate the two original contributions to the literature on global value chains and we argue that combining the understanding of interactive learning and national innovation systems with the global value chain perspective is one way to reestablish the critical potential of the original ideas that became diluted in connection with the wide diffusion of the concept. We also argue that combining the innovation system and the value chain perspective is useful when it comes to develop a more satisfactory understanding of how countries can evade the poverty trap and the middle income trap.

## **Introduction**

Today the term national innovation system appears in several different domains within social science and engineering and it is widely used in policy circles all over the world. The concept reflects an assumption that the pattern of innovation differs between countries and that such differences can be explained by systemic features: The components of the innovation system are different and they are linked differently to each other and such differences in economic structure and institutional set up are reflected in the rate and direction of innovation.

We will take as starting point ideas presented in the very first contributions that made use of the innovation system concept, Freeman (1982) and Lundvall (1985). There is some overlap between them but the perspectives are quite different. Freeman’s analysis refers to macro-phenomena and to international trade and development while Lundvall (1985) refers to the micro level where innovation is seen as shaped by user-producer relationships. We will argue that they are complementary and that

they can be used to span and dissect important themes in the more recent literature on innovation systems and global value chains.

The concept national innovation system may be seen as a new combination of two different perspectives, one developed within the IKE-group at Aalborg University and one developed at Science Policy Research Unit at Sussex University. The concept came out of bringing together an understanding of innovation as rooted in the production system (Aalborg) and an understanding of innovation as rooted in the science and technology system (Sussex).

The Aalborg approach was inspired by the concept ‘national production systems’ as it was used by French Marxist structuralists such as Palloix (1969) and Bernis (1971). Esben Sloth Andersen (1992) criticized and developed these ideas by introducing an evolutionary perspective with focus upon innovation with the aim to overcome the limitations of what he saw as a too static framework. Another important inspiration for the Aalborg group’s work on innovation systems came from Björn Johnson (1992) who linked innovation and learning to the socioeconomic characteristics of national institutions. Lundvall (1985) took inspiration from early work by Andersen and Johnson when studying user-producer interfaces as reflecting economic structure as well as institutional characteristics.

Scholars at SPRU were involved in a series of empirical projects that brought forward the interaction that took place in connection with innovation processes in industrial enterprises (Rothwell 1973; Rothwell 1984). One of Freeman’s favorite themes in lectures in the early 1980’s was about how innovation studies could overcome the apparent contradiction between supply and demand driven innovation through understanding innovation as an interactive process. While the IKE-group started from the production system and developed its understanding of innovation and learning on this basis the Science Policy Research Unit pioneered the mapping, comparing and analysis of national science and technology systems – a concept used by OECD already in the beginning of the 1980’s. This is reflected in Freeman (1982) where the focus is upon the role of Technological Infrastructure.

It is important to note that the two first contributions that made use of the concept (Freeman 1982 and Lundvall 1985) aimed at understanding national economic performance in terms of competitiveness and economic growth and that the analysis was critical both to mainstream economics and dominant economic policy prescriptions. They were critical to development strategies based upon ‘pure markets’ and night watcher states and to discourses that presented lower wages as the best cure for weak

competitiveness. Both of these contributions were placed in the tradition of political economy and the power dimension was taken explicitly into account. Freeman (1982) referred to differences between the rich and the poor countries in terms of their capacity to set the global rules of the game and pointed to the important role of state intervention to close technological gaps while Lundvall (1985) analyzed how gaps in competence and economic resources between users and producers led to ‘unsatisfactory innovations’ when either the user or the producer took a dominant position.

In the ensuing diffusion and use of the innovation system concept these critical dimensions were almost lost and they were definitely marginalized. Scholars at business schools and technological universities as well as economists in international organizations such as OECD and the World Bank used the concept in a technocratic way and neglected the power dimension.

### **Technological infrastructure and international competitiveness**

Around 1980 the OECD Directorate for Science Technology and Industry (DSTI) established a group of experts to analyse ‘Science, technology and competitiveness’ with Sir Ingram as chairperson and Francois Chesnais as secretary. After a series of meetings the group finalized a report 1983 that introduced the concept ‘structural competitiveness’. The report demonstrated that short term variations in wage costs and currency rates had only limited effects on long term differences that reflected the ‘absolute advantage’ of certain countries. The report concluded that investments in knowledge infrastructure and in human capital were crucial for the long term economic performance of the national economy. The report’s conclusions were controversial for OECD and it was never published (officially due to limited printing capacity – sic!) some of the main results were presented in an article in STI-review several years later (Chesnais 1987).

The group invited a number of external experts to write papers that gave insights in the link between science, technology and competitiveness. Christopher Freeman contributed with a paper on ‘Technological infrastructure and international competitiveness’ (Freeman 1982/2004). In this paper he made what might be the very first reference ‘the national innovation system’ (p. 550) and he outlined arguments for why national systems of innovation and especially technological infrastructure matter for the competitiveness of nations.

The paper is introduced by an important distinction between two different perspectives on international trade: One, prominent in standard economics, where the focus is upon comparative advantage and trade specialization and a second, where the focus is upon absolute advantage and competitiveness. The aim of the paper is to address issues related to the second perspective. The paper refers to the Leontiev paradox (Leontiev 1951) and to attempts to dissolve the paradox by analyzing the role that technology plays for the patterns of trade specialization (Posner 1961; Hufbauer 1966; Vernon et al 1967).

Freeman then moves on to an discussion of the literature on the role 'non-price factor' in trade citing works by respectively Kravis and Lipsey (1971) and Posner and Steer (1979) indicating that factors related to quality and reliability are more important than price for users' selection of means of production. He also refers to 'the Kaldor paradox' (Kaldor 1978) showing a 'perverse' relationship between national cost levels and export shares for the 1960's and 1970's.

As Freeman points out (with the exception of Kaldor's paper) the empirical results that he quotes operate at the sector level showing that in most sectors technology (as reflected in R&D-intensity and patenting) is an important factor when it comes to explain international specialization. They only indirectly address the question why countries remain in a dominating position for a longer period when it comes to trade and economic growth through innovation.

In order to respond to that question he uses economic history as method and shows how technological and economic world leadership has shifted from the Great Britain to Germany and he gives a detailed analysis of how Japan on the basis of investment in knowledge and innovation is successfully engaged in catching up with the US and with the lead European countries.

One original and interesting element in Freeman's paper is his reading of Friedrich List (Op.Cit. pp 552-557). He recognizes the well-known fact that List challenges the free trade ideology of Adam Smith and that List argues in favor of protecting infant industries. But he also shows that List's most severe criticism of Adam Smith is that Smith neglects the importance of 'mental capital' and the quality of the labor force: 'his free trade theory *takes into account present values, but nowhere the powers that produce them.....*' see (List 1845, p. 208).

According to List, it is only when you take into account the learning processes in the production sphere that you can understand why, under specific circumstances, the principle of freedom of trade may need to be subordinated to the need to foster competences in the production sphere. A related argument for

protecting domestic market is that it will attract foreign tangible and intangible capital contributing to the formation of mental capital. In both cases List's focus is upon the dynamics of innovation and competence building:

*The present state of nations is the result of the accumulation of all discoveries, inventions, improvements, perfections and exertions of all generations which have lived before us; they form the mental capital of the present human race, and every separate nation is productive only in the proportion in which it has known how to appropriate these attainments of former generations, and to increase them by its own acquirements.* (List 1841, p. 183)

Freeman concludes the paper by arguing that the international monetary systems needs to recognize that there are no mechanisms that automatically will overcome major trade disequilibria since those will reflect structural factors difficult to change in the short run. In the absence of a new international economic order where surplus countries accept to transfer technologies and support the building of strong innovation systems in the deficit countries the outcome at the global level will be deflationary.

At the national level he points to the need for public investments in education and research and in technological infrastructure. He ends the paper by arguing that these traditional priorities need to be combined with a new emphasis on understanding what kind of 'coupling' mechanisms linking to each other education systems, scientific institutions, engineering, business and marketing that characterize the countries that have been successful in catching up.<sup>1</sup>

In this context he makes a reference to the research program of the IKE-group at Aalborg University:

*The research at Aalborg on the interdependencies between various groups of firms in promoting technical progress in certain key sectors of the Danish economy is also highly relevant here (Andersen et al 1981).* (Freeman 1982, p. 550)

This reference points indirectly to the second early contribution to the development of the NSI-concept (Lundvall 1985).

## **Product innovation and user-producer interaction**

In the period 1980-1984 the Aalborg group hosted a major project on the impact of the use of micro-electronics on international competitiveness – the MIKE-project. At the time there were many parallel

national projects going on using various methods to capture the impact on productivity, employment and balance of payment. Some of those used macroeconomic models and input output tables while others studied specific sectors and the impact at the level of the firm. The Mike-project defined the units of analysis as 'industrial complexes' and analyzed four 'industrial complexes' that constituted important components of the Danish economy (Agro-, Office automation-, Environmental- and Textile-Industrial complexes).

The project gave special attention to the interface between users and producers of means of production that embodied information technology and studied how the specific characteristics of the user-producer relationships shaped the technologies developed and used. The project demonstrated several cases of producer dominance and pointed to the importance for national economic performance of giving users, including workers and consumers, stronger competences to cope with the new technologies.

Lundvall (1985) was inspired by the results obtained in the MIKE-project. It addressed two sets of issues, one related to economic theory and one related to the understanding of the innovation process. It presented innovation as an interactive process where the feed-back from users' experience was seen as crucial for the success of innovation and on this basis it demonstrated that an economy characterized either by 'pure markets' or 'pure hierarchies' would experience little (product) innovation. On this basis it was argued that markets where new products are introduced are 'organized' markets or semi-hierarchies. The analysis pointed to the limits of neo-classical economics but also to the limits of transaction cost economics as presented in Williamson (1975).

Second, with reference to the MIKE-project's analysis of industrial complexes it gave several examples of 'unsatisfactory innovation' reflecting a combination of uneven market power and uneven distribution of competence between the producer and the user. It also broadened the use of the concept of user-producer interaction to include universities as producers and industrial enterprises as users showing why this interaction would always be disharmonious since the user and producer operated with different modes of learning. In this context appeared what might be the first printed reference to 'innovation system' (Lundvall 1985, p. 36).

There is some overlap between these two first contributions to the understanding of innovation systems. As mentioned above, while analyzing the role of international specialization and competitiveness, Freeman points to the importance of 'coupling' from invention to innovation and from

original innovation (creation) to diffusion and use and as well to the complex process of ‘matching scientific and technological opportunities with the needs of potential users of innovation’. The analysis in Lundvall (1985) is built upon studying ‘Danish’ industrial complexes but three of the four cases refer to industrial complexes that are quite dependent on imports when it comes to the technologies used (this is especially the case for textile machinery). The paper also introduces ideas similar to what can be found in recent literature on Global Value Chains:

*The world economic system might be regarded as a complex network of user-producer relationships connecting units dispersed in economic and geographical space. (Lundvall 1985, p. 34)*

*International specialization might be regarded as reflecting competition between verticals or production rather than competition between national industries. (Lundvall 1985, p. 34)*

Some years later (in Lundvall 1988) the patterns of user-producer relationships were presented as a micro-foundation for the concept national innovation systems. It was argued that the interaction with domestic users is facilitated by short distance in terms of Geography, Culture and Language. This general argument was supported by empirical analysis of trade specialization showing that there was a correlation between the specialization in a specific commodity group on the one hand and the specialization of machinery to be used in the same sector. Home markets were important for those developing new production technologies (Fagerberg 1988).

Lundvall (1992a) may be seen as an attempt to combine and further develop the two perspectives presented in respectively Freeman (1982) and Lundvall (1985). In the first part of the book the focus is upon the role of economic institutions and structure in national innovation systems. The second part analyses different domains within the innovation system (work organization, cluster-formation, finance, public sector and STI-institutions). The third part is explicitly on the openness of national systems and refers to trade, integration and FDI.

Chapter 3 in the book used the user-producer perspective to explain why national systems remain quite resistant to the trend toward globalisation (Lundvall 1992b). It is argued that domestic interaction benefits from a shared language and from nation specific economic institutions since it reduces transaction costs and raises the returns from interactive learning. In the introduction to the book it is emphasized that all national systems are becoming increasingly open. But this is not seen as a reason

not to further develop and use the NSI-concept. It is argued that globalization makes it even more necessary to understand the historical role as well as the ongoing transformation of national innovation systems.

### **Each of the origins gives rise to new streams of analysis**

Each of the two pioneer contributions has stimulated specific research efforts related to innovation systems. The literature on catching-up may be seen as a logical follow-up to Freeman's reference to List and to his macro-perspective on economic development. While Freeman (1982) points to the difficulties to establish quantitative empirical analysis given the lack of data for less developed countries, much of the work on catching up has been empirical and aimed at testing his hypotheses. More specifically this literature has tested the relative importance of 'openness' vs. factors related to the strength of the national innovation system. In the next section we summarize the main results from this literature.

The literature on cluster formation and regional innovation systems developed by economic geographers may be seen as a follow-up to the analysis of user-producer interaction in Lundvall (1985). To begin with this literature gave major emphasis to the importance of local interaction. Later on it developed the analysis and pointed to complementarity between global (pipelines) and local (buzz) interaction. This evolution of ideas about interaction in space was interconnected with an analysis of distinct kinds of knowledge and different forms of learning. Below we will focus upon how this literature has developed its view of the role of distance in connection with the interaction that characterizes the innovation process.

### **What are the prerequisites for Catching Up?**

Fagerberg's contributions on competitiveness and catching up may be seen as following a trajectory that was outlined in Freeman's paper from 1982. While Freeman with reference to lack of data especially for the least developed countries used qualitative and historical arguments to indicate the importance of technology for national economic development, Fagerberg, starting with his Ph.D.-thesis (1988b), has engaged in a life-long effort to analyze quantitative data in order to sort out what are the main factors that contribute to economic growth and international competitiveness in countries at

different levels of development (Fagerberg 1993, Fagerberg 1994, Fagerberg 2010 and Fagerberg 2011).

His works show that technological capabilities (the national innovation system) and factors having to do with ‘governance’ are crucial for economic development while factors cherished within Washington consensus such as ‘openness’ (to trade and foreign direct investment) and the prevalence of western political institutions do not favor economic development – especially not in the least developed countries. In Fagerberg (2010) where he summarizes much of his work on why growth rates differ he demonstrates that a broader definition of ‘openness’ is significant for economic development. Openness to ideas, to entrepreneurial effort and to people (including tolerance to minorities) are positively correlated with national economic performance.

These conclusions are in line with the main results presented in Fu, Pietrobelli and Soete (2011). Their analysis aims at understanding the role of national and international sources of knowledge and innovation. It is built upon an extensive literature review on the impact of foreign direct investment and it refers to a different type of data than the empirics used by Fagerberg (their evidence is from case studies of global value chains in emerging economies) and they find that:

*The evidence suggests that, despite the potential offered by globalization and a liberal trade regime, the benefits of international technology diffusion can only be delivered by parallel indigenous innovation efforts and the presence of modern institutional and governance structures and a conducive innovation system. (Fu et al, 2011, p. 1210)*

They conclude that “Without indigenous innovation the income gap between rich and poor countries will never be closed”.

These results support Freeman’s 1982-analysis where he, with reference to Friedrich List, argues that building national technological infrastructure and a strong national knowledge base should be a major focus for development strategies. Fagerberg’s analysis adds to that perspective the importance of governance (rule of law, intellectual property rights, corruption) as well as an openness to ideas. Neither Fagerberg’s nor the analysis of value chains in emerging economies indicate that the least developed countries would benefit from engaging in ‘free trade’ and giving more free access for

foreign capital without simultaneously building technological capabilities and ‘upgrading’ national governance.

### **Interactive learning in regional systems of innovation**

While much of Jan Fagerberg’s work may be seen as following the trajectory outlined in Freeman (1982) economic geographers used some of the core ideas in Lundvall (1985) in a similar way to develop further the analysis of why certain activities tend to be located together in a specific region. The analysis of processes of innovation and not least the diffusion of innovation was, of course, not new for this interdisciplinary discipline. Torsten Hägerstrand’s seminal contributions on time and space models were linked to an analysis of innovation diffusion in space including reflections on the importance of face to face interaction. His dissertation from (Hägerstrand 1953) represented a major milestone.

In the entrance to the 1990’s Krugman and colleagues (Krugman 1991; Krugman and Venables 1995) presented quantitative growth models that signaled ‘the new economic geography’. Their models took aboard most of the main assumptions characterizing neoclassical economics but loosened up for some – most importantly they allowed for increasing returns to scale, oligopolistic competition and costs of transport. This invasion of a rather narrow economics perspective where it was assumed that regional agglomerations could be explained by rational behavior of fully informed agents left many economic geographers uncomfortable. Neither did it match well with the classical approach of Hägerstrand who, while using quantitative modeling, always emphasized the human and cultural dimensions of geography and preferred to work within an evolutionary perspective where uncertainty is seen as fundamental for outcomes.

In this climate many economic geographers and experts on regional development saw the new perspectives emerging within innovation studies developed by heterodox economists as a more relevant inspiration for their research. The concept of interactive learning was used in Cooke and Morgan (1990) to explain economic agglomeration in Europe. The combination of the specific focus on user-producer interaction (Lundvall 1985) and the more general concepts innovation systems (Lundvall 1988) and ‘the learning economy’ (Lundvall and Johnson 1993) inspired concepts such as the learning region and regional innovation systems. Nordic scholars such as Malmberg and Maskell (1999) and

Asheim (1996) took some of these concepts as basis for developing theoretical and empirical work in new directions.

Further developments by Aalborg economists of the understanding of different types of knowledge and in modes of innovation (Lundvall and Johnson 1994; Jensen et al 2010) also influenced this literature. A major argument for why proximity between users and producers was critical to innovation was that important components of knowledge were tacit (for in depth analysis see Gertler 2007 and Asheim and Coenen 2005). But it was also recognized that knowledge may be more or less codified in different sectors and in different technologies and that this fact was important for understanding differences between industries in degrees of localization and internationalization across.

One of the most important contributions was the paper by Michael Storper (1995) who made use of ideas from (Lundvall 1985) to introduce 'untraded interdependencies' as a key concept aimed at giving regional economics a new theoretical foundation. Here he argued that vertical linkages such as those between producers and professional users were only one example of 'untraded interdependencies'. Others were related to the employment contracts and reflected in informal labor market institutions at the regional level. Such relationships could be more or less hierarchical and be more or less built upon trust. While most other scholars in economic geography draw rather practical implications from the analysis using it primarily to argue that proximity is important and using it to explain the formation of clusters, Storper brought forward and developed further the underlying theoretical ideas. He summarizes his conclusions in three points:

1. Technological change is path dependent.
2. It is path dependent because it involves interdependencies between choices made over time - choices are sequenced in time, not simultaneous, and often irreversible.
3. These choices have a spatial dimension, which is closely tied to their temporal uncertainty and interdependence. Some inter-organizational dependencies within the division of labour, that is input-output or network relations, involve some degree of territorialization. But in all cases where organizations cluster together in territorial space in order to travel along a technological trajectory, they have interdependencies which are untraded, including labour market relationships, and 'conventions', or common languages and rules for developing,

communicating and interpreting knowledge (though direct input-output relations may also play a role here).

Storper (1995) was not unaware that globalization was an ongoing process but he argued that those who saw it as a hegemonic trend that met with little resistance had given too much attention to techno-economic input-output relations and too little to untraded interdependencies including those not related to user-producer interactions. He used the concept of localised 'economic conventions' related to the knowledge system and to labor markets as signifying such interdependencies.

The work by Edward Lorenz with colleagues on national differences in the organization of work may be seen as a follow up of these ideas. Such differences constitute an important but neglected dimension of Europe's national innovation systems and learning economies. In Lorenz and Valeyre (2006) it is demonstrated that work is organized quite differently in different national systems within Europe and that workers have very different access to jobs offering access to learning. In Arundel et al (2007) it is demonstrated that there is significant correlation between national performance in terms of innovation and the predominant forms of work organization. These differences typically reflect both differences in formal institutions surrounding the labor markets and 'conventions' strongly rooted in national systems.

The first wave of research on regional clustering taking Lundvall (1985) and Lundvall (1988) as inspiration emphasized the forces that lead to agglomeration and often it was assumed that agglomeration could be explained by the character of knowledge exchange in connection with local input-output or user producer relationships. At the level of national innovation systems it was also assumed that user-producer relationship could explain the relative stability in international specialization. Empirical work did not always support this perspective and increasingly it was found that:

1. The vertical couplings between firms within regional cluster were not always highly developed. Increasingly the vertical division of labor in product chains was further developed and different steps were distributed at different locations, sometimes at locations across the globe.
2. While the interaction with domestic customers and suppliers was more frequent when developing new products the less frequent interaction with distant customers and suppliers outside the national system played an important role especially in connection with path-

breaking and more radical innovations. Firms and clusters that combined ‘local buzz’ with ‘global pipelines’ were more viable and performing better than those depending only on local interaction.

These observations emphasized the need to combine a national perspective with a wider view, a need reinforced by the globalization of financial markets, by economic integration in Europe and by the increasing number of firms that behave as if they were foot-loose. In the introduction to the Handbook in Economic Geography (Clark, Feldman and Gertler 2000) these are the main arguments for why a national perspective is insufficient. But the conclusion is still that national systems matter. It is actually said that “As representatives of political agency they may be more important than ever.” Where the authors see a weakening of the role of national systems is especially in the tendency toward decoupling between private economic interest and enterprise and the home nation.

### **The Global Value Chain approach**

It is interesting to note that in the handbook on economic geography (Clark, Feldman and Gertler 2000) there is only one reference to ‘global commodity chains’ in spite of the fact that the introduction argues that global and sub-national economic processes should be given more attention. This reflects that the community of scholars who developed the global value chain approach had their belonging to development studies a sub-discipline clearly separated from regional studies and from the community of scholars working on issues related to economic geography in the North.

The main research question in recent global value chain research is: How does the character of the global production chain contribute to or hinder the upgrading of activities in firms located in less developed economies? The complementary question is how the character of the chain affects the distribution of value produced along the chain. This leads to the third question: Does the integration of local firms into global chains contribute to economic development in developing countries?

One early major contribution to this field of research was the edited book by Gereffi and Korzeniewicz (1994). The book brought together contributions by scholars with different background. Some of the contributions were case studies while others were historical or theoretical. The main theoretical references were to respectively Immanuel Wallerstein’s contribution on the world system and global commodity chains (Wallerstein 1974) and to Michael Porter’s work on competition and innovation

(Porter 1987). The most important analytical step taken was Gereffi's distinction between producer driven and user driven value chains. This constituted the beginning of a discourse on 'governance' that later became dominated by references to transaction cost analysis.

Another important reference is to Humphrey and Schmitz (2002). Those two scholars have affiliation at IDS at Sussex University. During the 1990's their focus was upon how the new understanding of industrial districts and cluster formation developed in Europe could inspire strategies for industrial development in developing countries (Humphrey 1995, Schmitz 1995, Humphrey and Schmitz 1996 and Schmitz 1999). Schmitz introduced the concept 'collective efficiency' as characterizing successful clusters a concept close to untraded interdependencies and shared economic conventions.

Humphrey and Schmitz (2002) is an important paper since it marks a bridging between the Global Value Chain literature and the cluster literature as it emanated from IDS at Sussex University. It is also important since it on a few pages introduces some fundamental concepts that have shaped the value chain discourse onwards. First it makes the distinction between four forms of industrial upgrading:

1. New process
2. New product
3. New function
4. New sector

As compared to the innovation literature the third form of upgrading is of special interest since it goes beyond technical innovation. It may be seen as a form of innovation resulting in a 'new organisation'. In the context of the global value chain literature it has a more specific connotation and it is assumed to be of great strategic importance. The value chain is seen as encompassing different functions spanning from exploitation of natural resources and manufacturing to R&D and marketing. It is assumed that firms that control the R&D and marketing functions can extract more value than those firms that are engaged exclusively in natural resource extraction or manufacturing. Even when firms succeed in developing new products and more efficient processes, they might gain little in terms of value if they remain a producer without access to R&D or without a strong position in end-user markets. For the demand driven chains the most important factor is the control of end-user markets, including establishing a strong brand. For the producer-driven chains the most important form for function

upgrading is related to the building of R&D-capacity. Multinational firms that control these functions are assumed to be able to dominate and 'organise' the whole value chain.

The second conceptual contribution relates to different degrees of dominance and it refers to the governance of networks. The analysis takes Oliver Williamson's transaction cost theory (Williamson 1975) as its starting point. It is argued that four types of relationships can be distinguished in the value chain:

1. Arm's length market relations
2. Networks
3. Quasi Hierarchies
4. Hierarchy

The dominating form will depend upon a series of factors. Quasi hierarchies may reflect a combination of monopoly position of the buyer, need for speedy response among suppliers, limited capacity of suppliers and complexity in the product. It is argued that in a dynamic perspective the entrance of local firms into quasi hierarchies may support upgrading at least in terms of products and processes.

The paper points to the importance of understanding the role of global linkages for firm level upgrading. But it also specifies that in order to be successful integration needs to be combined with investing in knowledge within the firm and that the more demanding forms of upgrading require a strong innovation system and active innovation policies.

A further step toward developing the understanding of governance of global chains was based upon the work by Sturgeon on modular production networks. Sturgeon (2002) argues that the modularization of information technology production chains should be seen in the light of transaction cost theory. By standardizing and codifying interfaces between those producing components and the major computer firms it has been possible to reap scale economies in production without imposing inhibitive transaction costs. It is argued that this is 'a new American model of industrial production' that can be applied in other sectors and set new global standards for the organization of value chains.

Gereffi, Humphrey and Sturgeon (2005) take these ideas into account and propose five different modes of governance:

- b) Hierarchy*
- c) Captive*
- d) Relational*
- e) Modular*
- f) Market*

It is assumed that the further down we get on this list the less is the element of dominance. As compared to the categories used by Humphrey and Schmitz (2002) captive corresponds to semi-hierarchical while the network category has been divided into two types of networks – relational and modular.

Three different characteristics are used to explain why a transaction interface takes on a specific form:

1. The complexity of information and knowledge transfer
2. The extent to which the information can be codified
3. The capabilities of suppliers

What is new as compared to Humphrey and Schmitz (2002) is that complexity now is explicitly related to information and knowledge and especially the emphasis upon the codifiability of the information. This is a theme that Aalborg economists have addressed in a number of papers where the emphasis has been upon the limited codifiability of crucial elements of knowledge – especially codifiability is limited for what they refer to as ‘know-how’ and ‘know-who’ (Lundvall and Johnson 1994; Johnson et al 2008)

### **Relating the Global Value Chain approach to the original NSI-contributions**

The global value chain literature may be seen as combining elements from the two original NSI-contributions referred to above. It makes an attempt to address the fundamental question raised by Freeman in connection with his interpretation of Friedrich List. Under what circumstances does participation in trade and openness to foreign direct investment have positive impact upon the knowledge base of the economy?

There are also much overlap between the global value chain literature and Lundvall (1985). Lundvall (1985) does propose that most markets are organized and that they are infiltrated by hierarchical relationships – uneven access to resources and competence are seen as resulting in ‘unsatisfactory innovation’ especially when technologies are systemic. Other important overlaps are the references to Oliver Williamson’s ‘transaction cost analysis’ and the idea that the character of knowledge as more or less codified – or technologies as more or less modularized - matters for the predominant form of governance.

Therefore combining the innovation system perspective and the value chain perspective may be a way to reestablish the critical intentions in the original contributions by Freeman and Lundvall. As mentioned much of the more recent literature and policy prescriptions have become technocratic and marginalized issues related to social phenomena such as power and trust.

But there are of course important differences as well. While the analysis of Freeman aimed at pursuing analysis at the aggregate level, something that was followed up in Fagerberg’s work most of the empirical work in the global value chain community is located at the level of the firm, the cluster or the value chain as a whole.

As Adrian Wood (2001) has pointed out there is a need to establish an analytical link from upgrading at the level of the single firm to the development of a whole economy. Without such a link there is no way that one can conclude that upgrading of a single firm or one single cluster of firms will contribute to economic development at the country level. This ‘fallacy of composition’ may actually be the weakest point in the global value chain analysis. What might be good for the single firm might not be good for a cluster, a region or a national economy.

When it comes to the micro-foundation for innovation systems and value chains there are also important differences. Lundvall (1985) and especially the economic geographers who made use of and further developed his ideas have insisted upon in depth analysis of why specific activities become located together. Here the focus has been upon the character of knowledge and learning processes as well as upon localized ‘institutions’ and ‘economic conventions’.

The global value chain literature tends to give less emphasis to analysing cultural, economic and political geography. This reflects that globalization is seen predominantly as bringing institutional

convergence between national economies. This contrasts with the innovation system perspective where globalization is seen as a process that might make specific national patterns more disparate leading to divergence not only in terms of economic structure but also in terms of institutions.

The value chain analysts tend instead to give more weight to relative costs. Their starting point is empirical observations of increasingly global commodity chains and to some degree they seem to take for granted that national governments have to respect the principles of comparative advantage. It is paradoxical that value chain analysis developed mainly by sociologists has ended up with a somewhat uncritical use of relative cost and transaction cost theory.

### **On the importance of building a strong national innovation system**

Another issue where the two streams of thought diverge in terms of emphasis relates to the relative importance of domestic technological capacity and outcomes of participation in global value chains. The paper by Giuliani, Pietrobelli and Rabelotti (2005) is interesting since it makes an attempt to present a picture of local vs global interaction in Latin America on the basis of no less than 40 case studies. Their conclusions are that you find elements of 'collective efficiency' in most clusters while the form it takes depends on sector as well as regional and national context. They also confirm that in order to explain how integration in global value chains affect upgrading in the firm you need to take into account the characteristics of regional and national systems of innovation and especially the firms' own efforts to engage in capacity building.

This corresponds to what is found in Malerba and Nelson (2011). Studying 'catching-up' in six sectoral innovation systems they find that industries differ in terms of how they link up with international firms. In some successful cases of catching up (automobiles in Korea) the access to foreign technology was crucial while in other cases (soft-ware, semi-conductors and agro-food) multinationals operated as customer lead firms in global value chains. But again in order to explain success and failure in catching-up – a phenomenon that could be referred to as 'sectoral upgrading' - they find that it is necessary to link the analysis of sector performance to the characteristics of national innovation system.

But the analysis of a wider set of cluster developments or of sectoral systems does not solve the 'fallacy of composition'-problem. Even if it can be shown that most clusters can benefit from firms' integration in global value chains and that specific sectors in a national system are characterized by catching up, it

does not follow that this will contribute to economic and social upgrading at the national level. This is not to degrade the importance of case studies and sector studies. But it is a strong argument for combining different methods including analysis at the macro level in order to make it possible to establish links from micro- and meso-levels to what happens at the national level.

## **Conclusions**

The two first papers that made use of the concept ‘innovation system’ (Freeman 1982 and Lundvall 1985) had in common a critical perspective on economic theory and on economic policy. They introduced the concept in two different contexts. Freeman analyzed the importance of building a strong technological infrastructure at the national level while Lundvall analyzed the interaction taking place at the level of the market between users and producers of new products.

Freeman (1982) has inspired Fagerberg’s work on catching up at the level of national systems. Fagerberg has developed methods to analyse in quantitative terms what Freeman derived as hypotheses on the basis of historical material. Lundvall (1985) inspired economic geographers such as Morgan, Cooke, Gertler, Maskell and Asheim who developed further the analysis of forms of knowledge in the context of geographic space. Michael Storper enriched the analysis by linking ‘nation specific conventions’ to ‘untraded interdependencies’.

The global value chain literature is overlapping with the two original contributions to the innovation system analysis. It shares Freeman’s assumption that capacity building (upgrading) is crucial for economic development and his concern that not all participation in international trade will contribute to that. It shares with Lundvall (1985) the assumption that most markets are organized (taking the form of networks) with patterns of dominance and it also links the degree of codification to transaction cost analysis.

The global value chain approach and the national innovation system approach differ when it comes to focus and level of analysis. While the focus of the system of innovation approach has been on the role of governments in building national infrastructure and upon the role of domestic linkages, the focus of global value chain analysis has been on trade policies and transnational linkages. Freeman’s insistence (see Sharif 2006) that innovation system analysis should give more weight to understanding macro-phenomena rather than just doing case and sectoral studies have not been taken up on a big scale

among those working on innovation systems.<sup>ii</sup> Among those who have done it most systematically we find Fagerberg, Dosi and Verspagen.

To link the transformation of economic structure to the process of economic growth and development is a major methodological challenge and it is of major importance for the design of trade, industry and technology policy. In classical development economics the growth of manufacturing activities (assumed to be characterized by increasing returns to scale and steep learning curves) was seen as crucial prerequisite for high rates of aggregate growth. This was presented as motivation for trade and industry policy aiming at import substitution. An interesting and promising recent approach is to link national economic performance not to specific sectors but to the characteristics of the technology predominant in the domestic high growth sectors (Keun Lee 2013).

An open and critical discussion between the national innovation system proponents and the global value chain scholars will prove fruitful when it comes to build an agenda for development research and when it comes to develop strategies for development. This assumption takes inspiration from the fact that the few countries that have been successful in catching up (Korea, Taiwan, Japan and China) have followed strategies where they gave attention both to building strong national innovation systems and to joining global value chains.

One ambitious goal for the research agenda could be to follow up on Freeman's interpretation of Friedrich List and develop a distinction between patterns of participation in the global economy that strengthen the national knowledge base (enhance mental capital) and patterns that undermine it. It could also address another question: Under what circumstances will the participation in global value chains contribute to learning and upgrading at the level of the firm (what is required in terms of strategy and absorptive capacity), at the level of a sector and to economic and social development at the national level (development strategy and strength of the national innovation system)? Such an analysis would of course need to recognize that context matters (the capacity of government, size of the economy, access to natural resources, world political position and level of income). The idea propagated by neoliberal economists that every single entrance of a domestic firm into a global value chain is promoting national economic development is of course naïve.

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<sup>i</sup> The ideas of structural competitiveness and the importance of national innovation systems for international competitiveness became more widely accepted in the 1990's and in the first year of the third millennium - at least in public discourse. The euro-construction, the euro-crisis and the EU-response to it, with a competitiveness pact that puts all the burden of adjustment on lowering wages and living standards in the south of Europe, is tragic evidence that those in charge of European economic policy have no understanding of the real dynamics of competitiveness (Lundvall and Lorenz 2012).

<sup>ii</sup> As Freeman puts it in an interview, "most of the people working on Innovation Systems prefer to work at the micro level and they are a bit frightened still of the strength of the neoclassical paradigm at the macroeconomic level, and I think that's where they have to work. You have to have an attack on the central core of macroeconomic theory. It is happening but not happening enough, not strongly enough argued." (Sharif 2006).