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Comparing national systems of innovation in Asia and Europe: theory and comparative framework

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Abstract

This chapter is structured as follows. In the introductory section, the objectives of the "Small Country Innovation Systems" book project are outlined and the methodological and theoretical foundations of the book are addressed. This is followed by an extended conceptual and theoretical discussion. Using the traditional systems of innovation approaches as the point of departure, we specify the most important concepts used in the book. Subsequently, we outline an activities-based framework for studying and comparing NSIs. Then we discuss the characteristics of the ten countries selected for study (Norway, Sweden, Finland, Denmark, the Netherlands, Ireland, Singapore, Hong Kong, Taiwan and South Korea). Finally we outline the common structure of each of the country studies, including the presentation of a model table of contents. The chapter ends with abstracts of the ten case studies.

Keywords: National System of Innovation, comparative framework.

Comparing national systems of innovation in Asia and Europe: theory and comparative framework

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Contents

1 Introduction[1]

The concept of national systems of innovation (NSIs) emerged in the late 1980s and started to diffuse more rapidly in the early 1990s with the seminal contributions of Lundvall (1992) and Nelson (1993). It has attracted the attention of many innovation researchers and policy-makers (e.g. Amable, 2000; Edquist, 1997, 2005; Freeman, 1997, 2002; Lundvall 1988; Mytelka and Smith, 2002; OECD, 1997, 2002; Saviotti, 1996) and has rapidly achieved broad international diffusion in both developed and developing countries (e.g. Correa, 1998; Kaiser and Prange, 2004; Liu and White, 2001; Niosi, 1991).[2] However, progress in refining the NSI concept has been uneven and difficult to assess, given that 'no single definition has yet imposed itself' on NSI research' (Niosi, 2002, p. 291) and many of the key terms are used in an ambiguous way. As argued previously (Edquist, 2005, pp.201-203), there is therefore a need for theoretically based empirical research to 'straighten up' the approach and make it more 'theory-like'. A comparative research project on varieties of NSIs, as well as determinants of innovation processes within them, may make particularly valuable contributions to such an effort.

The 'ten countries' research project addressed in this volume – so called because it compared ten 'small economy' SIs – started operating in a practical sense in the latter half of 2002. However, it also had a lengthy 'pre-history', in which different versions of the project description were discussed by various constellations of researchers from some of the countries that were finally involved.[3] Eventually, the project started up in 2002-2003,

some ten years after the publication of Lundvall's and Nelson's landmark anthologies on NSIs.

As a consequence of the long build-up to this project, the ground was rather well prepared by the time that financing arrangements for the project had been finalized and the first project meeting was held in Copenhagen in August 2002. At that meeting we could collectively define the project objectives listed below by selecting from a broader range of objectives discussed during the 'pre-history'. The following objectives were agreed upon:

1. To further refine, elaborate and operationalize the SI approach. This means making the approach more 'theory-like'. [4] Moreover, 'straightening up' the approach theoretically should go hand-in-hand with increasing the usability of the SI approach for empirical studies, by:

    - developing concepts and methodologies suitable for empirical analysis
    - translating its key concepts into empirical 'correspondents', i.e. variables reflecting concepts, indicators measuring variables, and using comparable sources (e.g. data bases) in quantitative work
    - developing a 'framework' for empirical studies of NSIs that includes both quantitative and qualitative elements. Alternatively this might be called a 'methodology' for analysing different NSIs in a comparative perspective

2. To use the SI approach by actually carrying out (quantitative and qualitative) empirical and comparative studies of different NSIs

3. To draw policy conclusions. This means studying earlier and current innovation policies that have been or are being pursued in the ten countries. It also means identifying 'problems' and opportunities that should be subject to future innovation policy in the ten NSIs, based on an analysis of strengths, weaknesses and challenges in these systems

In order to achieve these objectives, conceptual, theoretical and methodological work was conducted partly outside the ten-country project, and published in Edquist (2005). Some of the main results are summarized in Section 2 below. Within the project, we devoted much effort to transforming key concepts into empirical correspondents by developing quantitative indicators of relevance to NSIs. We discussed the so-called indicator work at workshops in Oslo in March 2003 and in Taipei in November 2003.[5]

At these early workshops, collective demand emerged among the researchers for a joint conceptual and comparative framework. To make the project truly comparative, it was agreed that we should develop a common framework that could be used for all the case studies of NSIs. In Taipei, a number of people argued for a very standardized, detailed and rigid framework, but others wanted more degrees of freedom. The consensus that finally emerged was that we decided to carry out work that would facilitate cross-national comparisons of the same elements and activities in all NSIs. This would be accomplished by using the same concepts, the same comparative framework and a standardized structure of presentation, rather than simply producing a collection of individual – and idiosyncratic – case studies. At the same time, however, each case study would also point to unique features of the NSI in question. We agreed that we did not only want to tell ten separate stories, but also create a basis for comparative analysis. The

underlying conviction was that this approach would increase the quality of all the national studies and – even more so – of the resulting book. The common comparative framework and the streamlined structure of presentation provide opportunities to highlight diversity as well as similarities among the national systems studied

The Swedish team was given the responsibility of preparing a draft proposal for developing the comparative framework. A draft of the framework was sent out to the project participants for comments, and, on the basis of many such comments and further revisions, it was finalized and distributed in February 2004 (Edquist and Hommen, 2004).[6]

Since the SI approach is still diffuse and under-theorized (Edquist 2005), we were certainly not able to come up with a perfect comparative framework. There is simply no such thing as an optimal framework, since the SI approach as such is still evolving. That consideration made it even more important for us to reach a compromise on the comparative framework for this project. There were a number of trade-offs that had to be made in designing the ad hoc comparative framework that we eventually agreed upon.

Formulating a framework to be used by all is also a sensitive thing in the academic world. Researchers are independent creatures and do not want to be too closely governed or managed. We want to be free to design and carry out our analyses in the way we believe is the best. To achieve comparability, it was therefore very important that everyone participating in the project could influence the design of the comparative framework. Consequently, the design process required several rounds before consensus could be reached. As editors of this volume, we are extremely grateful that the

participating national teams decided to follow the framework, once we had agreed on it. We greatly appreciate their flexibility and generosity!

In addition to concepts and theory, the framework addressed the propensity to innovate in NSIs, consequences of innovation, the role of globalization for small NSIs, and innovation policy.[7] We agreed that the framework would serve as a basis and a common structure for carrying out the ten empirical studies included in this volume. Drafts of these studies were discussed at the workshop in Lund in September 2004. Subsequently, they were revised, discussed again at the Seoul workshop in March 2005 and then finalised for publication. In this process, we designed and developed the case studies upon the basis of the comparative framework, which, in turn, was 'theory-based'. The framework and the related conceptual and theoretical issues are discussed in Section 2 below.

The remainder of this chapter is structured as follows. This introductory section is immediately followed by an extended conceptual and theoretical discussion. Using the traditional systems of innovation approaches as the point of departure, we specify the most important concepts used in this book. Subsequently, we outline an activities-based framework for studying and comparing NSIs. Then we discuss the characteristics of the countries selected for study. Finally we outline the common structure of each of the country[8] studies, including the presentation of a model table of contents.

2 Conceptual and theoretical framework

For the reasons explained above, it is highly advantageous for a project dealing with different NSIs in a comparative perspective to use the main concepts in the same way in all of the national studies. It is also important that the theoretical framework is similar – and explicit. In this section, therefore, we will specify the key concepts used in this book, as well as the theoretical approach agreed upon by the participants in this project.

2.1 The traditional SIs approaches

When the project started (in 2002) the SI approach had, as discussed above, been well established for more than a decade and had become very widely diffused. The approach had also been developed theoretically thanks to the contributions of a very large group of scholars with different disciplinary backgrounds. However, broad acceptance and further development along a variety of different trajectories had naturally led to many ambiguities and inconsistencies in the research literature on SIs.

As discussed elsewhere (e.g., in Edquist, 1997), the term NSI was first used in published form by Freeman (1987). He defined an NSI as 'the network of institutions in the public and private sectors whose activities and interactions initiate, import, and diffuse new technologies' (Freeman, 1987, p. 1).[9] Subsequently, Lundvall (1992) and Nelson (1993) both published their major anthologies on NSIs, but used different approaches to the study of NSIs. Nelson's (1993) book included case studies of the

national systems of innovation in 15 countries – and is, in that respect, similar to the present volume. The Nelson anthology emphasized empirical case studies more than theory development.[10] These case studies, moreover, were not designed to have the same structure and focus. Some of the studies in this book focussed narrowly on national research and development (R&D) systems, but others were broader in scope. In contrast, Lundvall's (1992) book was more theoretically oriented and it followed a 'thematic' approach rather than a 'national' one. It placed interactive learning, user-producer interaction, and innovation at the centre of the analysis.

Lundvall argued that 'the structure of production' and 'the institutional set-up' are the two most important dimensions that 'jointly define a system of innovation' (Lundvall, 1992,p. 10).[11] In a similar way, Nelson and Rosenberg (1993) singled out organisations supporting R&D – i.e., they emphasized those organisations that promote the creation and dissemination of knowledge as the main sources of innovation. Organisations disseminating knowledge include firms, industrial research laboratories, research universities and government laboratories.[12] Lundvall's broader approach recognised, though, that such organisations are 'embedded in a much wider socio-economic system in which political and cultural influences as well as economic policies help to determine the scale, direction and relative success of all innovative activities.' (Freeman, 2002, p. 195). Thus, both Nelson and Lundvall defined NSIs in terms of determinants of, or factors influencing, innovation processes.[13] However, they specified different determinants in their definitions of the concept, presumably reflecting their judgment about the most important determinants of innovation. In brief, they used the same term

but proposed different definitions, thus contributing to the ongoing lack of a generally accepted definition of NSIs (Niosi, 2002, p. 291).

As we have seen, Nelson and Lundvall offered definitions of NSIs that focussed on their constituents (e.g., the main organisations and institutions as well as relations among them). As already noted above, Lundvall (1992) promoted a 'broad' conception of NSI's – embedded in a wider socio-economic system. In contrast, Nelson (1993) advanced a more narrow approach focussing on national R&D systems and organisations supporting R&D as the main source of innovation. Remarkably, these two approaches have not really confronted each other within the research literature. Instead, researchers have tended to adopt one or the other of these two basic approaches, or to elaborate variants of them, without giving much consideration to the alternative approach. Thus, Lundvall et al. (2002, p. 217, n.2) have discussed the further development of their 'broad' approach to NSIs without making many explicit comparisons with the 'narrow' approach, except to comment that their own approach is particularly 'relevant for understanding economic growth and innovation processes in small countries'. Similarly, Laredo and Mustar (2001) have applied the Nelsonian version of the NSI concept in their international survey of research and innovation policies without much consideration of its merits relative to the Lundvallian alternative.[14] It is fair to say that these two versions of the NSI concept have enjoyed a peaceful coexistence, and there has been only a limited dialogue between them in the research literature. We will return to this question in the theoretical discussion that follows in Section 2.3 of this introductory chapter, as well as in the concluding chapter of this book.

A more general definition of an SI includes 'all important economic, social, political, organisational, institutional and other factors that influence the development, diffusion and use of innovations' (Edquist, 1997, p. 14). If an SI definition does not include all factors that influence innovation processes, one has to argue which potential factors should be excluded – and why. This is quite difficult since, at the present state of the art, we do not know the determinants of innovation processes systematically and in detail. Obviously, then, we could miss a great deal by excluding some determinants, since they might prove to be very important once the state of the art has advanced. For example, 25 to 30 years ago, it would have been natural to exclude the interactions between organisations as a determinant of innovation processes. Both the relationships among the factors listed and the actions of both firms and governments are included in the general definition above. This definition, moreover, is fundamental to the 'activities-based' approach to studying SIs (Edquist, 2005; Edquist and Chaminade, 2006) that we will discuss in Section 2.3. Obviously, this is a conception of SIs that is as broad as Lundvall's, if not even broader.

2.2 Main terms used in this book

Everyday language and the scientific literature ('general systems theory') give a common answer to the question 'What is a system?' focussing on three features (Ingelstam, 2002).[15] First, a system consists of two types of constituents: components and relations among them. The components and relations should form a coherent whole, with properties different from those of the constituents. Second, the system has a function –

i.e., it is dedicated to performing or achieving something. Third, it must be possible to discriminate between the system and the rest of the world (i.e., the system's 'environment') – that is, it must be possible to identify the boundaries of the system.[16] (Edquist, 2005) Obviously, for empirical studies of specific systems, one must know their extension.

Making the SI approach more theory-like – as proposed in Section 1 - does not require specifying all components and all relations among them in detail. At the present state of the art, this would be too ambitious. For the time being, it is not a matter of transforming the SI approach into a 'general theory of innovation', but one of making it clearer and more consistent so that it can better serve as a basis for generating hypotheses about relations between specific variables within SIs (which might be rejected or supported through empirical work). Even the much more modest objective of specifying the most important components of the SIs, their main function and specific activities influencing the main function and the key relations among the components and the activities would represent a considerable advance. Used in this way, the SI approach can help to develop theories about relations between specific variables within SIs.

There seems to be general agreement in the literature that the main components in SIs are institutions and organisations – among which firms are often considered to be the most important organisations. However, particular definitions of SIs specify different sets of institutions and organisations and, moreover, set-ups of institutions and organisations vary across systems. Consequently, in a project such as this one, it is important to specify the main terms used. We therefore present, in Box 1, a list of specifications of the key terms used in this book.[17]

>>>>>>>>>>Box 1 in here<<<<<<<<<<

2.3 An activities-based framework for analysing SIs

As indicated in Box 2, the main or 'overall' function of SIs is to pursue innovation processes: that is, to develop and diffuse innovations. What we call 'activities' in SIs from here on are those factors that influence the development and diffusion of innovations.[18] We use the term activities as equivalent to determinants of the innovation process.

The theoretical framework employed in this book includes a central focus on 'activities' within systems of innovation. It is new in the sense that it focuses strongly on what 'happens' in the systems - rather than on their constituents - and that it, in this way, uses a more dynamic perspective.

The traditional SIs approaches, such as Lundvall (1992) and Nelson (1993) focussed strongly upon the components within the systems, i.e. organisations and institutions. Since the late 1990s, some authors have addressed issues related to the issue of specification of activities influencing the overall function of SIs (Galli and Teubal, 1997; Johnson and Jacobsson, 2003; Liu and White, 2001; Rickne, 2000).

Clearly, no consensus has yet emerged among innovation researchers as to which activities should be included and this provides abundant opportunities for further research. In Box 2 we present a hypothetical list of ten activities that we have adopted in this book. This list of activities is based on the literature and on our own knowledge about innovation processes and their determinants, as discussed in Edquist (2005) and

Edquist and Chaminade (2006). The activities are not ranked in order of importance, but the list is structured into four thematic categories: (i) the provision of knowledge inputs to the innovation process, (ii) demand side activities; (iii) the provision of constituents of SIs and (iv) support services for innovating firms. The activities can each be considered to be partial determinants of the development and diffusion of innovations. The list is certainly provisional and will be subject to revision as our knowledge about determinants of innovation processes increases. Public innovation policy is an element of all the ten activities.

>>>>>>>>>>Box 2 in here<<<<<<<<

In relation to the distinction between 'narrow' and 'broad' conceptions of SIs discussed in Section 2.1, the activities-based framework is certainly as broad as Lundvall's. We agreed at the Taipei workshop in November 2003 that we would use activities as the 'point of entry' into the subject matter and as a structuring device for the empirical studies of factors hypothetically influencing innovation processes in the NIS in the ten countries. Thus, the activities-based framework forms the basis of the common framework has been used in all the ten case studies of NSIs reported in this book, as discussed above, in the Introduction (Section 1). This volume is therefore the first comparative study of NSIs that has focussed on 'activities' in a systematic manner.

Our focus on activities has not meant, however, that we have disregarded or neglected the organisations and institutions that constitute the components of SIs. When addressing activities in the NSI studies we have also had to address the organisations (or

organisational actors) that carry out these activities and the institutions (institutional rules) that constitute incentives and obstacles affecting the innovation efforts of these organisations. In order to understand innovation processes we need to address the relations among activities and components, as well as among different kinds of components. In addition to basing this approach upon quantitative indicators, the case studies also include a strong emphasis on qualitative aspects – including narrative accounts – related to the creation, change and abolition of organisations and institutions, and to other activities.

To sum up, activities, organisations and institutions are discussed in an integrated manner in the longest section of the NSI studies (Section 4) presented in this book. The activities are used in each national study as the point of entry into the subject matter and serve as a structuring device. Where possible, the various studies also try to address with what effectiveness and efficiency the activities are performed, i.e. how they influenced the development and diffusion innovations.

3 Countries selected for study

As indicated in the Introduction (Section 1), this volume is intended as a contribution to the research literature on NSIs. Hence, this book is intrinsically based upon both Lundvall (1992) and Nelson (1993), as well as other literature on NSIs. As also suggested previously, certain parallels can be drawn between this book and both Nelson's and Lundvall's volumes on NSIs. On one hand, this book may be considered to resemble Lundvall's, insofar as it is theoretically oriented and follows a thematic approach. On the

other hand there are also very clear - and arguably greater - similarities with the Nelson anthology, since both this book and Nelson's are collections of national case studies. Therefore, it may be useful to make a somewhat more detailed comparison between these two works, focussing particularly on the countries selected for study.

The 15 countries studied in the Nelson book covered a wide range of different national contexts. Geographically, they represented four continents (North and South America, Europe and Asia). The countries selected included both large ones (e.g. the USA) and small ones (e.g. Denmark and Sweden). In addition, the selection of countries also represented different levels of economic development, including both industrialized countries (e.g. Japan) and developing countries (e.g. Brazil). In the book they were clustered into the following groups: 'Large High-Income Countries', 'Smaller High-Income Countries' and 'Lower-Income Countries'. Hence the dimensions of classification were large/small and high/low income. Another, more recent, edited volume on national systems of innovation (Lundvall et al 2006) addresses only systems in Asia, including large ones (such as Japan, India and China) and smaller ones (such as Hong Kong and Singapore).

In this book we address the following national innovation systems located in the two continents of Europe and Asia: Denmark, Finland, Hong Kong, Ireland, the Netherlands, Norway, Singapore, South Korea, Sweden and Taiwan. As we noted at the outset, though, not all these units are countries or nations in a political and cultural-historical sense (see endnote 2).

The title of our book refers to small country innovation systems. As can be seen from Appendix 1: Statistical bases of comparison for ten 'small country' NSIs in this book,

most of the ten economies are indeed small. Seven of them have populations of between four and nine million. The Netherlands (16 million) and Taiwan (23 million) are also fairly small. The main outlier in this respect is Korea, with a population of 49 million. Korea thus approaches some of the larger European countries (e.g., France and the UK) in terms of population size. However, (like nearly all European countries) Korea can still be viewed as relatively small when considered in relation to 'giants' such as the USA and Japan (or, for that matter, China and India). Thus, unlike Nelson's anthology, which made a point of including such large economies, the present volume develops an exclusive focus on small ones.

With reference to Nelson's other main set of selection criteria – i.e., high versus low income levels – we have deliberately opted to focus only on relatively high income economies. As shown in Table 1.2 of Appendix 1: Statistical bases of comparison for ten 'small country' NSIs, this volume, the ten small economies represented here were ranked among the top 28 (out of a total of 177) countries on the UNDP Human Development Index for 2004.[19] Moreover, four of these countries (Denmark, Ireland, Norway and Sweden) were ranked among the top ten. According to the same source, the ten small economies included in this volume had gross domestic product per capita rankings among the top 37 countries, with three of them (Denmark, Ireland and Norway) belonging to the top ten. Table 1.2 of Appendix 1: Statistical bases of comparison for ten 'small country' NSIs also indicates that all ten of these small economies have very high levels of individual life-expectancy and very high levels of combined enrolment in primary, secondary and tertiary education.

The combination of relatively small size with relatively high income implies a third quality of the ten small economies selected for this study – namely, dynamism. This quality can be measured in a variety of ways, and we will mention only a very few of them here. To begin with, these economies fare very well in terms of technological development, as measured by, for example, advanced infrastructure development. For instance, when 178 countries were compared with regard to Internet access in 2002, eight of our ten economies (Sweden, Denmark, South Korea, Norway, the Netherlands, Hong Kong, Finland and Taiwan) were ranked among the top nine, intersected only by Iceland as number 3. Further, the ten economies also have high ratings with respect to economic performance. In the 2004 issue of the Annual Review of Global Competitiveness published by the World Economic Forum our ten economies came out very well with regard to growth potential (WEF 2004). Six of them (Finland, Sweden, Taiwan, Denmark, Norway and Singapore) were ranked among the seven first countries (this series was interrupted only by the USA as number two). In addition, the Netherlands was ranked as number twelve (Balls, 2004).

More generally, these ten economies have all established reputations for success within the context of globalization and the advent of a 'new' economy where competition is increasingly based on innovation. Four of these economies have gained wide renown as the 'four tigers' of Asia, and they have at least one European counterpart in Ireland, which is also known as the 'Celtic Tiger'. Our other European economies represent the Nordic countries (sans Iceland) and the Netherlands. These countries have perhaps not attracted the same degree of publicity, but in many respects they have been very high achievers, as noted above. A recent study by Florida and Tinagli (2004) on 'Europe in the creative age'

pointed to a high degree of learning and innovativeness in the contemporary Nordic countries, with Sweden as the leading country, outperforming not only all of the other European countries, but also the USA. The other Nordic countries, as well as other small northern European countries, including the Netherlands, Belgium and Ireland, also scored highly on the 'Euro-Creativity index'. Although the ten countries are similar in many dimensions (size, economic performance, diffusion of ICT, etc), they are very different in many other respects – as we will see in the concluding chapter of this book.

As compared to the Nelson book, then, our selection of NSIs represents a narrower – or, rather, more focussed – sample with respect to the dimensions of size and levels of income. Its geographical coverage is also more restricted, representing only two continents instead of four. Based on these considerations, it might be argued that one advantageous feature of the present volume is that it deals with a set of countries that are – in some respects, at least – more directly comparable with one another than those included in the Nelson anthology.

Notwithstanding these considerations, we should urge some caution with respect to conducting comparative analyses that cover this whole set of cases. It is clear that our 'sample' of NSIs cuts across some fundamentally different contexts, which ought to be taken into careful account in any comparative analysis. First, our cases represent two very different regions of the world: the Asia-Pacific and North European regions. Second, these cases also constitute two very different groups defined from an economic history perspective. On the one hand, the Nordic countries and the Netherlands represent late industrializing countries whose economies reached the 'take-off' point in the early 20th century. On the other hand, the Asian and Irish economies represent 'newly industrialized

countries' that reached this point much later, and under different conditions These differences, among others, should be addressed in making comparisons across this set of cases – an issue to which we will return in the concluding chapter-

As stated in the Introduction, one of our objectives has been to contribute to the development of comparative studies of NSIs. One means of realizing this goal is, of course, to identify and describe comparable cases in a systematic way. Other means of increasing the potential for comparative analysis is to identify common bases of comparison and to elaborate a conceptual framework for this purpose. Thus, as compared to the Nelson book, we have also tried to increase the degree of comparability by using concepts that are standardized or harmonized to a larger extent and by adopting a common theoretical framework. Along the same lines, we have also streamlined the structure of presentation in all the case studies. As noted previously, all of the national studies included in this collection use the same model table of contents, which will be discussed in the next section.

4 The structure of the case studies

In this section, the common structure of the case studies in this book is briefly outlined and explained. The discussion here concludes with the presentation of a model table of contents used in all the case studies.

After a short introduction (Section 1), the case studies outline the main trends in the history in the NSI (Section 2). These opening sections are intended to characterize the

NSI, often in relation to a central theme identified in the title of the case study, and point out the most important aspects of the system's development over time.

In Section 3, the propensity to innovate (or innovation intensity) of the NSI is addressed. Ideally, this discussion addresses both the development (creation) and the diffusion of innovations, including product as well as process innovations.[20] To a large extent the Community Innovation Surveys and similar surveys carried out in non-European Countries have been used to describe the propensity to innovate in the various countries. To the extent possible, these descriptions of the propensity to innovate are structured in order to facilitate the development of a comparative perspective across the various case studies.[21] Some of the data on which these comparisons are made, as well as additional data, are presented in Appendix 1: Statistical bases of comparison for ten 'small country' NSIs in this book.

As discussed above in Sections 2.2 (including Box 1) and 2.3, the main function in systems of innovation is to pursue innovation processes – i.e. to develop and diffuse innovations. Hence, the development and diffusion of (different kinds of) innovations is what 'comes out' of the systems. These outcomes are measured and assessed in Section 3's discussion of the 'propensity to innovate' (or 'innovation intensity').

The propensity to innovate is actually what should be explained– if possible – by accounting for the determinants of the development and diffusion of innovations. In the conventional terms of scientific method, the propensity to innovate is 'explanandum' and the determinants are the 'explanans'. These determinants were referred to as 'activities' in Section 2.3, where we hypothetically listed ten such activities. They were clustered in four main categories (see Box 2). In Section 4 of the case studies, these ten activities are

discussed in depth. Due to the detailed description of these activities, Section 4 is actually the longest part of each national case study.

The research question asked in Section 4 is, in effect: 'What are the national characteristics of the factors (or 'activities') that influence (product and process) innovation processes in the NSI?' [22] In this section, the country case studies aim at identifying factors that influence – and, in this sense, help to explain – the propensity to innovate.

Systematic identification of such determinants of innovation processes is a surprisingly under-researched area in innovation studies. Partly for this reason, but also because of the very complex nature of innovation processes, as well as the difficulty of developing causal explanations in the social sciences, none of the case studies arrives at a 'complete' causal explanation of the propensity to innovate in their respective NSIs. What they do present is a structured and illuminating discussion of the factors that influence the propensity to innovate. What we have learned in the work of this project is that a much deeper analysis of each of the potential determinants is both necessary and possible – but far beyond the scope of a volume such as this. For that reason, many of the researchers involved in this project have discussed the possibility of writing a whole book on their respective NSIs.

As pointed out in Section 2.1 above, the generally accepted definitions of SIs do not include the consequences of innovations, and the various systems of innovation approaches do not, as such, deal with the consequences of innovations. However, innovations, developing and diffusing in innovation systems, have extremely important consequences for socio-economic variables (such as productivity growth, employment

and sustainability). Therefore, Section 5 in the case studies provides a brief discussion of some consequences of innovations, mainly emphasising consequences for productivity growth[23] (although some case studies also mention other effects, such as employment and sustainability). This issue could also, of course, have been dealt with at much greater length and depth in specialized analyses than has been possible in a section in a chapter in an edited volume.

This project has also sought to counter the criticism that NSI analyses pay too little attention to 'external' factors by explicitly taking into account processes of globalization and issues raised by this phenomenon. Globalization is dealt with as a basic issue and profoundly integrated into each of the national studies. Thus, we have dealt with aspects of globalization when discussing the various activities pursued in the NSIs (see the discussion above of Section 4). We have also tried to address the extent to which various activities have been influenced by globalization. Because of the importance of the issue for this project, each national study also includes a section summing up the impact of globalization on the NSI (Section 6). In Section 6, we address questions such as the following:

- What have been the relations between globalization and NSIs?
- What does globalization mean for the NSIs of small countries?
- How has globalization influenced NSIs – positively and negatively?
- How has globalization influenced innovation policies of small countries?
- How has globalization been incorporated into innovation patterns – e.g., in capturing technological opportunities abroad and capturing global market opportunities?

- How have various countries influenced processes of globalization?

We will return to the issue of globalization in the concluding chapter of this book

A general definition of innovation policy was presented above in Box 1. Just as in the case of globalization, innovation policies are discussed in relation to various activities addressed in Section 4 of the case studies – but we also devote one separate section to innovation policy in each case study. In the context of this book 'innovation policy' means two things:

1. The policies that have historically been pursued in the ten countries, and
2. Policies proposed for the future.

We deal with both these aspects of innovation policy in the case studies. To analyse national innovation policies, it is necessary to relate them to strengths and weaknesses of the NSI. On this basis, innovation policies are discussed in Section 7 of the case studies. This section addresses both those policies that have been pursued during the last few decades and those proposed for the future. Since policy will be one of the key issues discussed in the concluding chapter we abstain from going deeper into this issue here.

The description above of the contents of the various sections results in the following model table of contents that is used in all country chapters.

>>>>>>>>>>Box 3 in here<<<<<<<<

This model table of content is not followed slavishly by all authors. All authors have addressed all the headings outlined above. However, in order for it not to become too much of a straightjacket, many chapters have improved upon the outline by adding

various sub-sections, to account for national peculiarities and deal with issues that may not be as relevant or as important in other countries. The length and weight of each of the sections also differ among the chapters. Thus, we have ended up with a joint structure pointing out the 'minimum' requirements for what should be addressed and included in all the national studies. This framework is intended to be a common denominator to achieve comparability, without being too inhibiting. Therefore, additional issues are covered in the country case studies and the way that specific issues are covered varies across the chapters. This diversity is in the interest of comparability as well as of creativity!

Another salient feature of both the framework and the flexible manner in which it has been implemented is that the borders between sections are not knife sharp. For example, institutions (rules of the game) are mentioned in many sections, since they are certainly relevant for demand, for R&D and other knowledge inputs, etc. In addition, however, institutions are also addressed in a separate sub-section. A further example concerns the provision of organisations. Like the provision of institutions, this topic is the subject of a separate sub-section – but is also addressed under other headings in each national case study. There are also differences in the approaches to and coverage of the same heading across the different country studies. In some chapters, for example, 'provision of organisations' is dealt with exclusively in terms of the birth and death of firms, and other kinds of organisations are dealt with elsewhere. In other chapters, a focus on new public sector organisations is developed under this heading, and firms are addressed elsewhere.

Notwithstanding this kind of flexibility, the fact that the model table of contents is used in all country chapters means that they all address the same issues and activities in similar ways. It also means that comparisons between the various cases are facilitated by the

adoption of a common framework, as should be obvious to the readers of this book. To a large extent, however, we will leave such comparisons to be drawn by the readers themselves. Only a few dimensions will be explicitly compared in the concluding chapter.

The readers will probably have views about which national studies provide a better structure and content under each heading than do others. On this basis, the next attempt - by us or by others - at systematically describing NSIs in a comparative manner will provide an alternative which competes with the attempts that are included in this book. The same is true with regard to the framework outlined in Box 1. There are certainly other ways to specify the main terms, and others should be encouraged to elaborate them. However, we do have the view that specification as such is a virtue. There is no advantage to using common terms in ambiguous and unclear ways.

To sum up, we have managed to use a fairly standardized conceptual 'language' and to structure the case studies along similar lines. We believe that using this common 'format' is an achievement; certainly, it has not been done before in a comparative study of several NSIs.

5 Final remarks and overview of the chapters

The remainder of this book is dedicated, for the most part, to the presentation of the national case studies. There are two main groups of chapters: the first presents the case studies of what we identify as the fast growth countries during the last three decades (Taiwan, Singapore, Korea, Ireland, Hong Kong), and the second presents what we call

the slow growth countries (Sweden, Norway, the Netherlands, Finland and Denmark.[24]. With regard to these case studies, it should be said at the outset that all authors have been forced to economize very much with regard to space. And, as noted above, most authors would actually have wanted to devote a whole book to their respective NSIs. We are confident that some of them will do so in the future!

5.1 Part I: Fast growth countries

5.1.1 Taiwan

Following a NSI approach, this chapter addresses the story of economic transformation in Taiwan. It emphasises the key role of policy in leading the process of systemic upgrading, which has involved complex processes of co-evolution among actors, institutions, knowledge, technology and markets. Three elements are emphasised here. The first is the role of Taiwan as a latecomer economy, learning to compete in world markets. The second concerns the strategic role of the government in changing the economic base for competition on the part of Taiwanese firms. The third is specialization, referring to a unique capacity to adjust quickly to patterns of change in global demand by upgrading and excelling at the project execution level in original equipment manufacturing (OEM) and original design manufacturing (ODM) production.

5.1.2 Singapore

Singapore has experienced rapid economic and technological development since political independence in 1965. Until the late 1990s, this rapid growth was accomplished largely through heavy reliance on foreign direct investment, leveraging foreign multinational corporations (MNCs) to transfer and diffuse technology to local companies and employees. The government has played a central role in this development, providing incentives for MNCs to locate in Singapore, developing relevant training programmes and institutions, providing the necessary infrastructure and setting an example by itself being a lead user of new technologies. However, this approach has also produced an imbalance in the NSI, with greater emphasis on the adoption of advanced technologies at the expense of developing indigenous R&D and innovation capabilities. This is reflected in the relatively low innovation intensity and patenting levels prevailing in Singapore up to the late 1990s. Since then, policy efforts aimed at redressing this imbalance have been implemented, particularly over the last two to three years. However, weaknesses remain, particularly in the basic research system and the technology entrepreneurial ecosystem. Future policy will need to address these issues, including mechanisms to fund technology commercialization efforts, programmes to promote R&D cooperation with international partners and, perhaps most fundamentally, policies to foster a change in the cultural mindset in order for the population to embrace entrepreneurship.

5.1.3 Korea

Korea is comparable to Germany and the UK with regard to complexity and diversity of organisations, institutions and industrial structures. Its NSI has been developed through aggressive investment in R&D and innovation activities, led by large firms and the government. However, this has resulted in low innovativeness and productivity relative to the advanced countries, and lower gross domestic product (GDP) per capita than the first-tier Asian 'tigers'. Korea's NSI is characterized by a group of 'strong large firms and weak small firms' - that is, innovative large firms able to exploit technological and market opportunities abroad, and laggard small firms. In terms of public R&D, Korea has a relatively large government research institute sector, but university research activities are comparatively small. Industry networks comprising Chaebol groups and their affiliated firms are dominant in the major industry sectors, and university-industry-government research institutes networks are at an early stage of development. The education system in Korea has been continuously expanding, but is under increasing pressure to upgrade the quality of education being offered. The financial system, which is predominantly a banking system, has been reformed. Under the liberalized environment, which emerged rapidly after the 1990s financial crisis, coordination and networking of innovative actors and resolution of mismatches in the system of innovation have become urgent issues in Korea's bid to become active in knowledge generation and effective utilization of technology from abroad.

5.1.4 Ireland

High levels of inward investment have helped Ireland to achieve extremely rapid growth over recent years compared to other European countries. Innovation levels have also been high, supported primarily by inward technology transfer and despite historically low levels of both public and private R&D spending and weaknesses in Ireland's NSI. Acknowledgement of these issues in the mid-1990s, and increasing uncertainty over whether Ireland would continue to attract high levels of inward investment, led to a refocusing of policy towards support for domestic R&D, innovation and new technology adoption. Since 2000 in particular, public investment in higher education R&D has increased rapidly, supported by policy innovations such as the introduction of the Programme for Research in Third Level Institutions (i.e. organisations) and Science Foundation Ireland. Efforts to boost levels of business R&D and connectivity have also been intensified, with a particular focus on indigenously-owned and smaller firms. Over the same period, Ireland has tightened its intellectual property rights regime, strengthened corporate governance legislation and continued to develop organisations to support business start-up and service sector growth.

5.1.5 Hong Kong

From 1847 to 1997, Hong Kong was a Crown Colony of Great Britain. The five decades leading up to 1997 have seen Hong Kong becoming a newly industrialised economy and then developing extensive services to become an unrivalled trade hub between the

People's Republic of China and the rest of the world. This role has contributed directly to the prosperity and standards of living Hong Kong enjoys today. Since Hong Kong became a Special Administrative Region under Chinese sovereignty in 1997, however, a series of events have created new pressures on Hong Kong to diversify its role as a regional hub. One such event has been the accelerated integration of Hong Kong's production networks into the Chinese Mainland, specifically the Pearl River Delta region of Southern China. Another important event was the Asian financial crisis that struck in 1998, initiating a prolonged economic recession out of which Hong Kong has only recently emerged.

In reaction to these events, the Hong Kong government has launched major initiatives to improve innovation in the economy. The low level of R&D investment in industry has been gradually improving, and attempts have been made to generate new technologies through public support on a continued basis—to transform Hong Kong into an innovation hub with global links to and from China.

The point of departure for this chapter is thus that the transition to a new status, from that of a trade hub for China to that of an innovation hub, presents new challenges for Hong Kong's NSI. Hong Kong must leverage its unique position as a gateway that provides high value-added services to global production chains linking China and the world, and in the process upgrade its expertise and knowledge for trade and production chain orchestration into the resources needed to contribute substantially to product and process innovation in China.

5.2 Part II: Slow growth countries

5.2.1 Sweden

This chapter takes its point of departure in the so-called Swedish paradox, according to which the Swedish NSI is plagued by low pay-off in relation to very high investments in R&D and innovation efforts. Using new data, we show that this paradox is still in operation, i.e. the productivity or efficiency of the Swedish NSI remains low. We also specify the paradox in several respects. By focussing upon nine activities in the NSI, we attempt to explain why and how the paradox operates. The paradox is also related to the moderate growth of labour productivity in Sweden. Further, we show that the paradox is linked to globalization: internationalization of production by Swedish firms has proceeded further than the internationalization of R&D. On the basis of this analysis, we identify strengths and weaknesses of the Swedish NSI – many of which are related to the Swedish paradox. We take account of the history of innovation policy in Sweden and – on the basis of the analysis as a whole -- we identify future policy initiatives that might help to mitigate the Swedish paradox.

5.2.2 Norway

Norway ranks low regarding average innovation outcome, but performs well regarding economic output and standard of living. We provide a description of activities within the NSI, with a focus on technological trajectories. Norway has been blessed with an

abundance of natural resources, and this rich endowment partly explains the country's affluence based on resource extraction specializations. But an overemphasis on overall low innovation intensity is misleading. The specialization in low-technology resource extraction would not have been possible without innovation intensive technological trajectories working adjunct to resource extraction sectors, such as mechanical engineering, engineering consultancy and suppliers to the aquaculture sectors.

5.2.3 The Netherlands

The Netherlands NSI has deep roots in the history of the country. The industrial structure and the common mode of societal organisation (the 'poldermodel') go back to the 16th century history of the Republic of the Netherlands. At the end of the 1960s, the Netherlands was a leading industrial nation, and innovation (especially by a few large firms) was at the heart of this economic success. Since then, innovation intensity has been in relative decline, partly because other nations have successfully caught up. What results is a relatively rich NSI, in which many actors (public and private) play a role, the science and technology infrastructure is well developed, and innovation policy (including policy employing a systems perspective) has a long tradition. But performance is declining, in terms of both innovation and science and technology indicators, as well as in terms of economic indicators such as productivity. The challenge for innovation policy is to overcome this situation, but policy-makers have been faced with budget cuts, and, despite well-recognised elements of a systems approach in policy thinking, innovation policy is still very much steered by scoreboard indicators.

5.2.4 Finland

Industrial development in Finland can be divided into three phases: 1) a factor-driven economy from the mid-1800s to the early 1900s, 2) an investment-driven economy from the end of World War II to the 1980s, and 3) an innovation-driven economy since the late 1980s. Finland experienced a severe depression in the early 1990s, and the recovery from it was to a large extent due to fast growth in the information and communication technology (ICT) sector. Lately, innovative activity in Finland has been dominated by the electronics industry, as reflected in the success of this sector, and particularly of Nokia. Even though the electronics industry and especially Nokia dominate innovative activity in Finland, there are also other innovative sectors in the country, like knowledge-intensive business services. Many traditional sectors, like the engineering and paper industries, are also rather innovative by international standards. All in all, Finland ranks among the top countries in innovativeness. The future challenges of the Finnish NSI include strengthening of innovative activities in traditional manufacturing industries and in service sectors. In addition to technical innovations, the role of organiational innovations should be strengthened and technical and organisational innovations should be integrated more than is currently the case.

5.2.5 Denmark

The Danish NSI is characterized by many small and medium-sized enterprises (SMEs) with only a few (in international terms) large firms. In general, Danish firms are innovative (making both product innovations, process innovations and organisational innovations), but their innovations mainly take the form of incremental changes. Such innovations often reflect a practical and experience-based interaction between skilled labour, engineers and marketing people. The firms mainly build up competencies by employing experienced labour on a flexible labour market and through intensive inter-firm collaboration – especially with domestic and foreign customers and suppliers. However, there are signs indicating that important changes in the traditional Danish mode of innovation may be underway. First, Danish firms – including many SMEs – are increasingly investing in R&D, collaborating more with universities than before and employing more personnel with higher education. Second, ongoing globalization implies on the one hand an outsourcing of low-skilled jobs – for instance within traditional scale-intensive food processing sectors, and on the other an increasing number of high skilled jobs in high-tech sectors – for instance within biotechnology, ICT and various knowledge intensive service industries.

5.2.6 Concluding chapter

The concluding chapter of this book develops a comparative analysis that deals with only a very few of the many issues addressed empirically by the country case studies. The

concluding chapter focuses to some extent on issues related to globalization, but devotes most of its attention to innovation policy. Our concluding chapter is intended as a contribution to the comparative analysis of NSIs, conceived in the spirit of 'appreciative theorising'.

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[1] We are extremely grateful to several colleagues within the project for valuable comments on this chapter.

[2] By March 2007 'innovation systems' had 792 000 hits at Google and 'systems of innovation' had 224 000. As a comparison 'economics of innovation' had 219 000 and 'neoclassical economics' had 285 000 hits.

[3] Previous initiatives were taken by research groups in Aalborg, Denmark (Bengt-Åke Lundvall) and Oslo, Norway (Jan Fagerberg) before Lund, Sweden (Charles Edquist) was invited to take over the coordination.

[4] What this may mean is discussed in Section 2.2 below.

[5] Appendix 1: Statistical bases of comparison for ten 'small country' NSIs in this book is a result of that work.

[6] We received comments from all the national teams, and in some cases from several members of the same team. The framework was revised substantially on the basis of these comments. This introduction is partly based upon the framework, but certainly does not reproduce it entirely. (The framework document was quite specific and the document describing it ran to 112 pages.)

[7] We will briefly return to these issues later in this introductory chapter. In addition, globalizationglobalization and innovation policy will be discussed in more detail in the concluding chapter of this book.

[8] We have adopted the common term 'countries' in this introductory chapter and in the concluding chapter. However, Hong Kong is not, properly speaking, a country in the sense of a nation-state. Formerly a British Crown Colony, Hong Kong was made a Special Administrative Region of the People's Republic

of China by the Sino-British Joint Declaration of 1984, and assumed that status in 1999. However, the 1984 Joint Declaration ensured preservation of Hong Kong's capitalist system and 'way of life' for 50 years, and this principle is reflected in the 'one country-two systems' framework that was subsequently enshrined in the constitution of the Hong Kong SAR. The innovation system of Taiwan covers only the Republic of China, which operates like a country, but is considered to be a part of China. In addition, South Korea (The Republic of Korea) is only a part of the Korean peninsula and the case study of Ireland does not include the north-eastern part of the island (i.e., Northern Ireland).

[9] Freeman here means 'organisations' in the sense of actors and not 'institutions' in the sense of rules. In addition, we currently often use the term innovations instead of technologies – implying that we also include in this category new creations also of a non-material nature, e.g. service product innovations and organisational process innovations (see specification of key terms in Section 2.2 below).

[10] This emphasis is clear from Nelson and Rosenberg (1993, p. 4): '…the orientation of this project has been to carefully describe and compare, and try to understand, rather than to theorise first and then attempt to prove or calibrate the theory'. In the current project we have tried to do it partly in the contrary way – specifying concepts and theories first and carrying out empirical work in a comparative way thereafter.

[11] Lundvall use the term 'institution' in an ambiguous way. Sometimes, he uses the term in the sense of 'rules' only; at other times, he uses it to denote 'organisations' – see Section 2.2.

[12] Nelson (and Rosenberg) use the term 'institutions' to denote these organisations.

[13] Their definitions of NSIs do not include, e.g., consequences of innovation. This does not mean that innovations emerging in SIs do not have tremendously important consequences for socio-economic variables such as productivity growth and employment –on the contrary. Moreover, distinguishing between determinants and consequences does not, of course, exclude feedback mechanisms between them.

[14] Curiously enough, these authors see Nelson as the proponent of a 'broad' approach. But here they are drawing a contrast, not with Lundvall, but rather with Bozeman and Dietz (2001), who propose a definition of NSIs that is even narrower and more restrictive than Nelson's.

[15] Like the SI approach, general systems theory might be considered an approach rather than a theory.

[16] Only in exceptional cases is the system closed in the sense that it has nothing to do with the rest of the world (or because it encompasses the whole world).

[17] Before going into this definitional issues, we want to stress that definitions and taxonomies are neither right or wrong; they are more or less useful for certain purposes.

[18] The activities in SIs are the same as the determinants of the main function. An alternative term for 'activities' could have been 'sub-functions'. We chose 'activities' in order to avoid the connotation with 'functionalism' or 'functional analysis' as practiced in sociology, which focuses on the consequences of a phenomenon rather than on its causes, which are in focus here. (Edquist (2005), p. 204, n. 16). In order to avoid all connotations, the best would perhaps be to use term 'x' to denote the concept – but this might seem too radical for some social scientists.

[19] The human development index is a composite index that measures the average achievements in a country in three basic dimensions: life expectancy at birth, adult literacy and the combined gross enrolment ratio for education at all levels, and GDP per capita.

[20] Please see Box 1 for concept specifications and how 'development' and 'diffusion' of innovations relates to 'new to the market' and 'new to the firm' innovations.

[21] The reason for this is that it is not possible to say that innovation intensity is high or low in a certain system if there is no comparison with innovation intensity in other systems. This has to do with the fact that we can not identify an 'optimal' or 'ideal' innovation intensity. The notion of optimality will be discussed related to policy issues in the concluding chapter of this book.

[22] The innovation policies pursued during recent decades and relevant aspects of globalization are also discussed in the context of the factors influencing innovation processes. Since they are considered to be crucial issues in this project, they are also addressed in separate sections. They will also be discussed in the concluding chapter of the book.

[23] However, dealing with consequences for productivity growth is done in very different ways in each case study.

[24] Within these groups we simply present the chapters in reverse alphabetical order. The identification of fast and slow growth countries respectively is done in the concluding chapter.

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