National Innovation Systems and Regional Cooperation in Asia: Challenges and Strategies from a Study of China

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Abstract:

I provide a quick assessment of the effectiveness and potentialities of National Innovation Systems (NIS) in the Asia-Pacific for deeper economic integration. To this end,I formulate some preliminary policy suggestions aimed at enhancing the region's overall innovation strategy. My approach focuses particularly on the evolving relationship between China's NIS and the Asia-Pacific region with some references to Japan, Korea, Taiwan, India, Thailand, Singapore, Malaysia and Indonesia. I argue that while the policy challenges for regional cooperation are far from trivial, strengthening the NIS and the various sub- regional systems with a view to building up a broad-based and inclusive Regional Innovation System(RIS) for the Asia-Pacific can be a substantive area of enhancing economic integration in the Asia-Pacific . Conceptually, the paper presents an enhanced view of NIS for inclusive growth. I call this new model of regional innovation an "Augmented NIS(ANIS)". The attempt to build ANIS is one conceptually and practically sound approach towards enhancing economic integration in the Asia-Pacific. Three areas of concrete applications are suggested in the concluding part.

Keywords: National Innovation Systems (NIS),Augmented National Innovation Systems (ANIS), China, regional cooperation, Asia-Pacific Region

1.Introduction:

The aim of this paper is to provide a quick assessment[1] of the effectiveness and potentialities of National Innovation Systems (NIS) in the Asia-Pacific , and to formulate some preliminary policy suggestions aimed at perfecting the region's overall innovation strategy. As an illustrative strategy, my approach focuses particularly on the evolving relationship between China's NIS and the Asia-Pacific region with some references to Japan, Korea, Taiwan, India, Thiland and Indonesia. It will be argued that while the policy challenges for regional cooperation are far from trivial, strengthening the NIS and the various sub- regional systems with a view to building up a broad-based and inclusive Regional Innovation System(RIS) for the Asia-Pacific can be a substantive area of enhancing economic integration in the Asia-Pacific . Conceptually,

[1] The elaboration of a more thorough and formal assessment, designed also to be further developed as a practically usable policy tool, will be the ultimate object of a larger research project, of which the present paper is to be seen as an introductory working document.

the paper presents an enhanced view of NIS for inclusive growth. I call this new model of regional innovation an "Augmented NIS(ANIS)". The attempt to build ANIS is one conceptually and practically sound approach towards enhancing economic integration in the Asia-Pacific. The approach is developed following the general theory of complex socio-economic systems.

2. R&D and Innovation for enhancing economic integration in the Asia-Pacific within a Complex and Uneven Global System: Cross Country Sectoral Study and The Chinese Case Study within (Augmented) National Innovation Systems and Sectoral Innovation Subsystems.

The economics and the political economy of building RIS for enhancing economic integration in the Asia-Pacific cannot be discussed properly without generally understanding the economics of R&D and innovation in complex socio-economic systems within modern nation states. In a national context, treating innovations in specific sectors---e.g.,the ICT sectors--- as part of the techno-economic paradigm embedded in the nation state requires viewing the innovation process within a National Innovation System (NIS) and Sectoral Innovation Sub-systems (SISS) as a start.

The key to understanding the economics of innovation, particularly in the dynamic ICT, biotechnology, nanotechnology and other knowledge-intensive sectors in a regional and global context is to realize that a disequilibrium process has set in within the world economy of which the national economies and NISs including their SSISs are parts. During this process, the gap between the advanced countries of the world and most of the rest is widening. This disequilibrium process naturally is leading to rapid economic changes in the direction of even a greater unevenness in the Global Political Economy (GPE). These changes include intersectoral shifts toward the ICT, other high technology and knowledge sectors, changing skill requirements, high volatility of wages, profits and financial variables and consequent increase in uncertainty about the future states of the national economies and GPE as a system. The dynamics of this disequilibrium process must be studied through methods of understanding complexity. Clearly, our knowledge of such dynamic systems is still in its infancy; but much can be learned by studying some known features.

In the last twenty years, the frontiers of economics have moved far beyond the standard models of decreasing or constant returns where costs can not be decreased beyond a certain point, unless factor markets behave in a peculiarly decreasing marginal cost fashion. Leaving the perfectly competitive world behind, economists at the frontiers have been focusing on increasing returns to scale, economies of scope

and network externalities. The world of high technology in general and the ICT and knowledge sectors in particular, are characterized much better through these approaches than the old perfectly competitive models. Many models of imperfect competition have also been developed to study interesting and relevant phenomena such as R&D rivalry and R&D expenditures. The upshot of these developments is that economists at the frontiers of their discipline are much closer to understanding many aspects of the digital economy than they were ten years ago. In this paper I want to illustrate this point by discussing a recently developed theoretical approach within the context of NIS and SISS in an uneven world economy. The policy implications for the development of new technologies are quite striking.

2.1 National Innovation Systems (NIS), SISS, ANIS, Social Learning and Complexity

The National Innovation System--- also abbreviated as NSI or National System of Innovation---- can be broadly defined as the intersectoral flow of technology and information in the economy including households and individuals, productive enterprises and various institutions including both public and private educational and R& D institutions. All these can form a network which under appropriate circumstances can generate a self-sustaining innovative process on the national level.(Freeman 1987,1995; Nelson 1992,1993a,b, 1994, 1995; Lundvall 1992; Edquist 1997; Kim 2000; Kim and Nelson 2000; Lee 2006,2008; Lee and Lim 2001; Lee and Kim 2009; Khan1998, 2002, 2004a,b) . According to this approach, which I generally follow with some modifications described later, technological development requires a system of well-functioning institutional networks and such development when it occurs results from this complex system of relationships among different groups of actors who respond to appropriate policies in the socio-economic system. Most advanced countries are already societies with highly evolved NIS and SISS. Some NIEs in the Asia-Pacific region like China, India, Korea and Taiwan are developing such NIS and SISS with various degrees of success. Many poor countries are far behind. This is an example of what I mean by the unevenness of the global economy and globalization as a process.

My previous work on NIS and RIS (Khan 2002 and 2004a,b in particular) of the requirements of technical progress shows that we need both a deeper understanding of the disequilibrium processes at work leading towards multiple equilibria, and the economic implications of the complexities of the production and distribution aspects of new technologies. It is with a view towards capturing these complexities leading towards multiple equilibria that an alternative conceptualization of technology systems transition in terms of an *Augmented* NIS (ANIS) has been formulated by some economists (Khan 1993; James and Khan 1997; Khan 1998, 2001a,b;2002,2004a,b; Gabriele and Khan 2010). In addition to capturing both equilibrium and disequilibrium features of technological transitions, this broad approach can illuminate distributional issues as well. Since poverty alleviation remains on the agenda of the national governments of many Asian developing countries and the international development agencies, it can be argued that from this perspective at least the new approach has obvious relevance for the developing countries. But clearly, such distributional considerations are of importance in the advanced countries in Asia and elsewhere as well.

The key results for policy purposes will be described shortly; but first let us take a closer look at the concept itself and see how it can be applied to specific technologies and NIS in a particular Asian country.From here on, I wish to highlight the fact that my framework can be viewed as simply a variety of Augmented NIS (ANIS) and its various subsystems and therefore, I will be using the more general term from now on which also has the virtue of maintaining intellectual continuity with NIS and at the same time augment the range of the concept. One important extension captured in my fomulation is the explicit consideration of *both factorial and household income distributions* which interact in a causally reciprocal way with the technology systems.

2.2. An Augmented NIS and the linkages between industry and science: the Chinese example and possibilities for enhancing regional integration

As an example of Augmented NIS we can look at China. The claim is not that China has adopted an innovation system that is totally different, but rather that there is finally some official recognition in China that issues related to distribution and the maintenance of reasonably harmonious social relations can not be completely neglected in overall development strategy including the strategy for innovation. China's Augmented NIS has witnessed remarkable advances since the early 1980s, as a result of a series of reforms aimed mainly at improving its effectiveness and closing the excessive gap which traditionally separated university-based research activities from the technology absorption and innovation needs of the enterprises system. The main thrust of reforms has been to diversify the country's Augmented NIS and to strengthen its market-orientation (or market-compatibility), but the role of centrally-managed large, long-term research programs has also been enhanced. These reforms, along with the ever-expanding availability of financial resources made possible by economic growth and by the strong role of the national state, have allowed China to achieve remarkable advances. This has also led to the prospects for deeper integration with other Asia-Pacific economies through both international trade, investment and joint technological and infrastructural projects.

Several organizational and institutional structures which proved their validity in the context of developed market economies are also being studied, experimented with, and in some cases adopted in China, but such a pragmatic approach does not amount to an attempt to ape Western examples. The most visible change in China's Augmented NIS is probably the progressive shift of the bulk of R&D activities away from universities and specialized research centres and towards industrial enterprises. However, universities participate in many of the most ambitious basic research endeavours, and often play a crucial role in their implementation. For instance, universities carry out about 1/3 of the "863 projects" and 2/3 of the projects funded by National Natural Science Foundation (NNSF) (Wu (2007), Hu and Jefferson 2004). In order to re-balance the roles of the different actors in the R&D scene in favour of the academia, the Chinese government is earmarking an increasing volume of funds to elite universities, mainly through the Ministry of Education (MOE). Elite universities are expected to lead in national R&D programs and projects, facilitate technology diffusion and pullovers, promote spin-off companies, incubation centres, and open laboratories for R&D sharing, to bridge-in foreign technology and partners. This emphasis on the role of universities in engaging directly in the development, production, and commercialization stages of their research results has been dubbed "forward engineering " by Lee. According to him, forward engineering is a peculiarly Chinese component of the "Beijing Consensus", a comprehensive and

proactive catch-up strategy very different from the "Washington Consensus" and partly, but not fully similar to that followed before by other successful Asian latecomers such as Korea and Taiwan (see Lee 2006a, b). Among other initiatives, a very important one was project 211, aimed at funding the construction of campuses and developing new academic programs in key scientific areas all over the country during the 1996-2000 Five year plan period.

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Other programs promote specifically university-industry links. The first one of this kind was launched jointly in 2001 by the State Economic and Trade Commission (SETC) and the MOE. The goal of this program was to set up state technology transfer centres in six universities, in order to promote the commercialization of technological achievements. After a long debate that concluded with the official position that universities have a threefold mission - research, teaching, and commercialization - MOE issued another directive in 2002, encouraging the development of university start-up enterprises. Research and technological innovations are seen as crucial channels through which universities contribute to national and local economies.

As mentioned above, however, the bulk of China's R&D is presently being carried out by enterprises, many of which are large SOEs. China's large SOEs not only did not die out, but have managed so far to resist and even to thrive after over a quarter-century of market-oriented structural changes. SOEs reforms were carried out in the framework of a complex, ever-changing and opaque institutional environment, characterized by a weak and ambiguous -albeit increasing- degree of protection of property rights in general and of intellectual property rights (IPR) in particular. Shedding light on this apparent (for orthodox economics) paradox, most studies on innovation among Chinese productive enterprises found that substantial progress was going on, and that SOEs were capturing the bulk of S&T resources, but exhibiting a less-than-satisfactory capability of translating them into true production improvements. The innovative capability of SOEs, however, appears to have been further enhanced in the mid-2000s, thanks at least partly to the economies of scale and scope made possible by the "grasping the big, enlivening the small" policy. The combined profit of the 150 or so companies controlled by China's central government reached Rmb1,000 bn (USD140bn), more than 200% higher than five years earlier. By end- 2007, the list of the world's 10 most valuable companies contained four groups controlled by the Chinese state. The behavior of Chinese SOEs is also becoming more modern and effective in a number of areas, including their ability to attract top executive talents (Dodson (2008).

In China as elsewhere in the Asia-Pacific, R&D expenditure is positive and significantly correlated with firm productivity. The contribution of government R&D to firm productivity works mainly through an indirect channel, via the promotion of firms' own R&D, which appears to be a more effective policy tool than direct R&D grants. Other key sources of production improvement and innovation growth are each firm's absorptive capacity, the production network, openness, and managers' education. Market-oriented, competition-enhancing innovation system reforms are improving the effectiveness of the incentive structure and fostering S&T linkage activities. With respect to the impact of ownership type, SOEs perform worse than collective and private firms in terms of production

performance, but not in terms of innovation capabilities grants. The choice of innovation types among Chinese SOEs depends on the turbulence in the environment, and on the organizational resources, with market forces and internal governance simultaneously influencing SOEs' innovation patterns. In many SOEs, managers apply the technical innovation audit tool for benchmarking, thereby improving their ability to choose among different types of innovation mechanisms.

Due to the influence of the two main stakeholders (government and end-users), firms with a higher degree of government involvement and a correspondently lower degree of openness to the market exhibit a more widespread use of innovation mechanisms, thereby apparently contradicting the positive relationship between market focus and innovativeness traditionally posited by “Western” innovation management theories. This phenomenon is due largely to strong government interference in SOEs' behavior, in a context of relatively weak IPR protection. The government puts a paramount emphasis on long-term investments and makes a great effort to promote technological innovations, targeting them as important indicators of SOE performance and awarding resources to SOEs accordingly). SOEs, rely more on government-allocated resources, and therefore tend to perform better in areas that are encouraged by the government, such as new product development. As new product output is an important indicator of SOE performance, SOEs are incentivated to operate at the frontier of new product development. In our view, in spite of the relevance of static inefficiencies and distortions, SOEs' "distorted" behavior in the static sense can be associated with dynamic advantages in terms of innovative capacity and technological progress, with major spillovers benefiting the national economy as a whole. One also needs to take into account the existence of virtuous synergies with the non state-owned sector.

Notwithstanding China's Augmented NIS’s remarkable strengths, remaining challenges are formidable. For instance, Wang (2006) identifies a dualistic pattern in China's of technological development, with the export-oriented segments of the economy being relatively isolated from those producing mainly for the domestic market. Zeng and Wang (2007) stress the weight of constraints such as an insufficiently developed institutional framework, relatively low overall educational attainments, the lack of a large pool of world-class talents, the embryonic stage of indigenous innovation capacity, and insufficiently developed linkages between R&D and industrial enterprises. Other researchers point towards China's persistent weaknesses in technological cooperation between universities and industry, the inadequate integration of the country's Augmented NIS into the global innovation networks, and the need to develop a comprehensive , more refined technological strategy in order to achieve effective technology transfer from foreign technological leaders, while at the same time maintaining an appropriate balance between indigenous innovations and technology imports.

Without being exhaustive, one last feature of the still evolving Chinese Augmented NIS can be mentioned. Since the beginning of the new regime in the 21st century the increasing social and political tensions which inevitably accompany worsening income distribution have been noted carefully. The worsening distributional situation sets China apart from the other East Asian latecomer innovators. The

new regime seems committed to changing the distributional picture and managing social and political tensions effectively. The overall macroeconomic and innovation policies are influenced by these goals.

Apart from the already developed ANIS of Japan, the region's other players with strong capabilities for developing ANIS are India, Korea, Taiwan, Singapore, Malaysia, Thailand, the Philippines and Indonesia.[2] Viet Nam is at a lower stage of development but can potentially develop its ANIS integrated with the Asia-Pacific RIS soon. The present author has carried out studies on a number of these countries and several are ongoing. What can we conclude from the Chinese case study and these other Asian examples?

3.Conclusions

Although it is too early to draw definitive conclusions from this brief exposition, some tentative conclusions can be reached on the basis of the detailed studies some of which are summarized above.

First of all, the development of NIS in specific countries has led to a deeper integration in the region through the input-output structures of the innovating sectors. Through a policy of strategic openness, this can be further strengthened.

Secondly, the combination of innovation system building and cooperative regional infrastructure projects can lead to greater economic benefits and an understanding of gains from regional cooperation in the Asia-Pacific region.Here, using the huge surplus of foreign reserves built up by some Asian countries can be utilized to create regional public goods.

Finally, the incipient forms of cooperation in specific sectors (e.g., in energy between China and Japan, ICT between several Southeast Asian countries etc.) can also lead to deeper forms of integration. However, much more of an effort needs to be made here. Political mistrust and diverse issue-linkages need to be tackled skillfully with patience and determination by all the parties involved. Here, too, the ANIS approach can be beneficial at the regional level by delivering enhanced well-being through innovation for all the people.

To conclude, we note that the technological pace of innovation in the region is quite rapid. However, in the advanced countries this pace is driven by expected profit outlook which may vary over time. This is why strategic alliances between companies at the research and development phases may be beneficial. At the same time, given the need for competition to enhance both productive efficiency and consumer welfare, there has to be a clear distinction between a pre-competitive R&D phase and a more competitive production and marketing phase.

[2] For specific studies see the citations in the bibliography. Khan(2002, 2004, a,b) can be checked for Korea and Taiwan studies as well as references to Singapore, Malaysia and Thailand. Khan and Thorbecke(1988,1989) and James and Khan(1993, 1997) have done work on Indonesia and India which are cited in the reference section.

However, as the work in this area increasingly shows, this virtuous circle of diffusion and welfare increase is not occurring for all the economies of the global system. Particularly, the poor countries are being left far behind, thus increasing the technological divide. The fruits of globalization in innovation are indeed unevenly distributed. This uneven distribution can be avoided in Asia by building upon its previous national development strategies and extending these towards building an augmented regional innovation system. More than any other region of the global economy, this looms as a feasible future for the Asia-Pacific. A future article will look at other partners in APEC from the Americas and Oceania as well.[3]

The countries that are falling behind themselves need to adopt a policy of strategic integration by inviting foreign technology and enabling precompetitive research and development through state incubators. In addition, wherever possible, supporting infrastructure — both hard and soft--- must be built through active public-private collaboration. Finally, the states of these economies of the global South can build regional cooperation around a few leading regional actors. In this paper, I have argued that Japan, Korea China, Singapore, Malaysia and India can play such roles in North East, South and Southeast Asia.

[3] Haider A. Khan, The Future of APEC and Regional Cooperation, Presentation for the Nov. APEC summit at the pre-summit conference at the University of Redlands, Ca. USA on Sep. 23, 2011

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