Supporting the diffusion of knowledge for international competitiveness: some policy implications

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Innovation systems and policy domains

In his influential, *Competitive Advantage of Nations*, Michael Porter argued that ultimately national competitiveness depends on the strength, or otherwise, of ‘national systems of innovation’.

Differences in national economic structures, values, cultures, institutions and histories contribute profoundly to competitive success. The role of the home nation seems to be as strong or stronger than ever. While globalisation of competition might appear to make the nation less important, instead it seems to make it more so. With fewer impediments to trade to shelter uncompetitive domestic firms and industries, the home nation takes on growing significance because it is the source of the skills and technology that underpin competitive advantage. 1

This perspective is of central importance in the concept of national systems of innovation (NSI). However, a close look at patterns of innovation in the Asia-Pacific region suggests that we should exercise caution in accepting the importance of national boundaries as the key organising element in innovation systems. Rather, I want to suggest here that they should be taken as a challenge, particularly in promoting policies for national competitiveness.

If we take the idea of a *national innovation system* as our starting point for policy analysis then we can observe the familiar notion of a ‘national innovation system’. However, if we take knowledge producing organisations and institutions as a starting point then we can observe sub-regional systems that may have entirely different characteristics. For example, in some industrial regions the public sector may be critical in generating technical training or providing technical equipment for quality development. In another region, and in another industrial sector, the firms themselves may be far more influential in producing and diffusing technical capability and raising quality for international competitiveness. In other words, the institutional mix and the ways that institutions are linked within them can serve to create quite different innovation characteristics.

Similarly, from an institutional perspective, it is also possible to observe what we can call a ‘transnational innovation system’. This kind of innovation system has its base in the interaction between human capital and innovative effort that *transcends* two or more countries. This idea is illustrated in Figure One.

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A major factor that has influenced the development and increased significance of transnational innovation systems in recent years has been the global trend toward the harmonisation of intellectual property legislation. While there are many elements that comprise a transnational system, the key organisational elements, not surprisingly, are transnational corporations. Their influence is pervasive. To the extent that IPR regulations are becoming equally enforceable in all location, national boundaries are becoming less important as boundaries to the production and diffusion of knowledge. Clearly, under the assumption of indistinguishable IPR regulations the corporations need not be constrained within state boundaries. Under these conditions the transnational corporation can develop strong alliances with firms or institutions, or innovation sub-systems in the various countries. Such alliances provide a bridge between the transnational system and innovation activities that would otherwise be constrained by state boundaries.

*Figure 1: National and Transnational Innovation Systems.*

These three levels of innovation or knowledge system: local, national and transnational present three different domains for policy influence. The distinction between these three different policy domains is crucial for designing and implementing policy for technological development. This is because an appropriate policy instrument for promoting innovation in one domain may be quite inappropriate in another.

This paper seeks to emphasise the importance of considering these three policy domains for promoting the diffusion of knowledge for international competitiveness. The role of intellectual property rights will be used to illustrate the importance of achieving a balance between different policy initiatives across these three different policy domains. It also outlines some policy implications for generating national competitiveness in each domain.

**National and regional perspectives in mapping the diffusion of technology**

A national perspective to S&T indicators shows that globalisation of market economies has done little to alter the control and distribution of scientific knowledge and technological expertise. This has tended to remain in the hands of the developed countries. Developed countries produce the bulk of scientific knowledge and creative
Scientific and engineering capabilities in developing countries tend to be concentrated in either foreign or joint venture firms or within a small number of state owned enterprises. The difficulty for knowledge diffusion and gaining competitive advantage in developing countries is therefore two-fold. They must seek to generate national capabilities and ‘capture’ such knowledge, but they also confront the more difficult task of diffusing such capabilities more generally throughout their economies. This means embedding technological capability within comparatively local systems of innovation. One of the major difficulties however, is that local systems are fragile because they are weakly connected to key national institutions. Such institutions include, financial, educational, scientific and administrative institutions. A purely national perspective can disguise internal weaknesses and strengths.

By taking a multi-level or regional approach to knowledge systems analysis this problem becomes more apparent and the appropriate remedies, perhaps more obvious. A regional analysis of some S&T indicators from China show just how different knowledge production and diffusion processes can be within international boundaries. The data shown in Table 2, for example, show that there are at least three different regional systems for producing and diffusing knowledge. Each has a rather different set of alliances between the institutions involved.

Firstly, as Table 2 shows, there is a group of high performing regions in terms of R&D, but not particularly strong in terms of R&D investments. Two examples are provided here by Guangdong and Zhejiang. This group also has comparatively low proportions of S&T personnel, is less dominant in scientific output but low proportions of employees in state owned enterprises compared to the dynamic township/village enterprise (TVE) sector. However, they have received considerable investments through the Torch and Spark Programs. They can be considered as the economic or commercial dynamos in the national system of innovation. Among this group it is likely that the comparatively low level of R&D investments is explained by alliances with foreign firms.

A second category comprises those regions that are high on R&D performance but less significant in terms of GDP. Beijing and Shanghai are typical examples here.
They are the top performers in terms of S&T indicators representing nearly a third of all national R&D investment, inventions and scientific publications. They also have the highest proportions of the country’s R&D personnel in R&D institutions. However, they have much higher proportions of SOE employees compared to group 1. Because of their strong science base they can be considered as scientific engines for driving the national system of innovation.

A third group comprises regions that are also high performers in terms of GDP, but have higher levels of investment in R&D compared to group one regions. Examples here are Jiangsu and Shandong. This group of regions has high levels of scientist and engineers in R&D institutions and industry. They have high levels of Torch and Spark investment and are strongly represented in scientific output. Like group one, they too, have high proportions of employees located in township/village enterprises. In short, this group is high performing in terms of GDP and most S&T indicators. Sichuan, although not as strong in terms of GDP would also seem to fit this regional category. This group of regions is equally strong in both scientific and commercial activity. In terms of a national innovation system they appear more independent than either of the other groups of regions.

What these three groups appear to represent is two different knowledge systems: a strong science based system predominantly linked to public institutions and state enterprises; and a commercial system, more responsive to market forces, less science intensive but more closely linked to the business sector and non-state enterprises. Group 3 in the above classification would appear to transcend the two systems.

The point of this example is to show that knowledge producing institutions can be engaged to different degrees and in different ways in different regional systems. Policy interventions to promote ‘national competitiveness’ and the diffusion of knowledge should take account of these differences. At the same time it is important to identify ways that regional differences might contribute to the broader national system.

The role of IPR in the diffusion of knowledge

A national perspective

Economic and technological development in the Asia-Pacific region has been uneven. The immense economic and technological capabilities of Japan and the United States, has placed them in a good position to supply technology to other countries in the region and to benefit from extended international standards controlling the use of intellectual property. This is consistent with the view that an international intellectual property rights system is more likely to benefit technology ‘suppliers’ than technology ‘purchasers’. This potential disparity in interests is particularly evident in relation to patents. During the TRIPS (Trade Related Industrial Property Agreement) negotiations, for example, developed countries viewed patents as a means to encourage industrial research and development. Developing countries, on the other hand have argued that patents restrict their capacity to capture and make use of
advanced technologies. Yet, as the world moves toward global consistency in intellectual property rights legislation it is not at all clear who will be the major benefactors of innovation. Even in the United States there are those who argue that the current trends in IPR legislation are stifling, rather than encouraging innovation.

There are a number of reasons for this. First, innovation is ultimately a complex social process: ideas, technology, and know-how coalesce. Thus, while intellectual property rights can be a powerful force in controlling the use of patents, industrial designs and trade-marks, they are less powerful in managing the development and flow of ideas and know-how. As a result, human resource and organisational capabilities will always be a powerful influence in determining who will actually benefit from IPR. Secondly, while there is a clear move toward the harmonisation of enshrined IPR legislation, the impact it has on innovation, will depend on how it is managed within different economies and how it interacts with other innovation policies. Figure 2 illustrates the rather different ways in which various innovation policies and instruments might influence the diffusion of knowledge.

See Figure 2

**A local perspective**

The trend toward the convergence, or harmonisation, of IPR legislation raises important issues about the development of innovative business and the organisational cultures of institutions involved with systems of innovation. As the United Nations Conference on Trade and Development (UNCTAD) has pointed out, linkages between international economic production, and the increasing governance of transnational corporations are:

...strengthened by the flow across borders of norms, values and routines (business culture) that are becoming of increasing importance to international competition in a more integrated world economy.

On the other hand, there is a growing body of literature concerned with innovation suggesting that beneath global trends in international business there is evidence of the emergence of new forms of ‘localism’.

This local - national - international tension in science and technology has led to considerable controversy in policy debates. On the one hand governments are

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5 See, for example, Pavitt, K. ‘Is technological Innovation now globalised?’ in *Local Matters*, (Ed. John Phillimore, Murdoch University, 1995.)
restricted in their technology development options by the global pressures of international business and international science. Multi-national corporations have the ability to influence the types of technologies that will dominate various socio-economic activities, to control the use and further development of such technologies, and to ‘capture’ the benefits of international science. On the other hand, national science and technology policy options are also restricted by specific localised capabilities such as: levels of industrial development; organisational capacities for innovation; and knowledge and expertise embedded in local communities and educational institutions. How can these pressures be reconciled?

In the late 1990s transnational organisations also include educational institutions, government funded research institutes and even governments themselves. The traditional alliance of science, government and industry established within national boundaries is becoming superseded by alliances of transnational corporations and governments predominantly influenced by global market forces and financial exchange. State boundaries in this context are becoming less influential in containing national benefits from international business. This, of course, creates dilemmas for national governments. To what extent, and how, should they provide incentives for their local firms to become embedded in transnational innovation systems?

_Dual perspectives concerning knowledge acquisition_

On the one hand there are many claims that IPR will stimulate local innovation. On the other hand there is a perspective that views the reforms as necessary for nations to become, as some observers from the Philippines have put it, a ‘worthy trading partner’. This has been portrayed by some as an irresistible imperative:

> A sign of a growing economy is the adoption and integration of policies enabling the economy to adjust to changes in a highly competitive global market. If the Philippines is to make its mark as a worthy trading partner to other countries, it must provide the mechanisms to make it attractive to foreign investors. One such mechanism is having a strong intellectual property rights system in place. From what has been achieved to date, it is clear the Philippines is serious in its efforts to strengthen its intellectual property laws further.

So the debates concerning compliance with TRIPS have two dimensions: a local dimension concerned with stimulating innovation; and an international trade dimension.

A major feature of knowledge diffusion, and a direct consequence of the globalisation of IPR, is the way that local knowledge is becoming subject to individual or corporate ownership, not necessarily involving the local communities that originally produced such knowledge. Local knowledge is often ‘tacit’, embedded in neither artifact nor explicit instructions. We now know that tacit knowledge, is an important ingredient in innovation, yet it remains largely outside the control of IPR systems. Consequently,

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there are a different range of policy options that might serve to promote the diffusion of tacit knowledge into local and national knowledge systems.

One of the few avenues open to local communities for retaining their local ownership is to enter the IPR arena themselves. This raises new debates at the local level about collective versus individual property rights and challenges long held assumptions about who should be the custodians of community, or public knowledge. This is apparent in countries such as Indonesia and the Philippines who seek to protect their biodiversity and their potential to derive commercial benefit from traditional knowledge concerning the use of plants and other biological organisms.

The struggle in these communities, rich in biological diversity and knowledge about its properties, but poor in their capacity to apply such knowledge for the commercial benefit of their members, already has international momentum. Sutherland cites a range of examples from around the globe where local communities have lobbied to retain rights over the exploitation of local knowledge. She argues that cultural politics pervades the globalisation of the formal intellectual property rights regime which applies to biological materials. 7

Innovation is ultimately a social process. It is neither lineal in its progression nor is it always clustered around specific technologies. Rather, it progresses in ebbs and flows and through all manner of social alliances, only some of which are bound through formal contract or other form of obligation. It is these knowledge-based alliances that most nourish innovation. It is a recognition of the value of this social process, over and above the value of codified intellectual property that helps explain why there is so little resistance on the part of technology purchasers to the legal demands of the ‘producers’ through TRIPS. In short, they have ‘other ways of getting there’.

There are, nevertheless, implications from converging IPR legislation that follow for the ebbs and flows of tacit knowledge. If technical and scientific tacit knowledge, with commercial potential, is primarily conveyed through social relations, either formal or informal, then it is likely that this will occur around the more technologically dynamic milieu. To the extent that codified and ‘protected’ technologies become clustered in various locations it is likely that such locations will attract a greater ebb and flow of tacit knowledge. Indeed, it is precisely such assumptions that underpin decisions of government to invest in science parks, technology incubators or ‘technology corridors’.

The problem for technology purchasing nations, however, is that by involving foreign firms in the innovation milieu, there is the potential that the net spill-over from foreign technologies to the host country will be less than the local spill-overs of tacit knowledge to the foreign investor. A failure to recognise the complexity of these processes can produce what might be perceived as rather simplistic policy recommendations. A multi-level analysis shows that for the IPR debate it is not so much a question about what nations may or may not benefit from an international IPR regime but rather which clusters or alliances of ‘interests’ will benefit.

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7 Sutherland *op.cit.* p. 299.
**Transnational, national and regional implications for international competitiveness**

National competitive advantage from IPR investments might emerge, not so much from a struggle between technology producing and technology using states as between competing knowledge systems. Such systems may be national, but they might also be regional or transnational. This means that one of the main tasks for governments is not so much to protect sovereign boundaries, but to find the most effective way to diffuse knowledge across them. The trend toward harmonisation of IPR carries with it the potential for judicial sovereignty to be displaced by international courts or a ‘Supercourt of the World Trade Organisation’. Such a trend is likely to be more conducive to the development of transnational, rather than national or regional innovation systems. The policy issue for national governments will be to seek to transform these developments to national advantage. Adopting a regional perspective for policy analysis would be a helpful prerequisite for doing so.

Major issues will concern not only how the technical and commercial knowledge and information are produced, controlled, and used, but also what sorts of organisations or groups of organisations should be involved. Who should or should not be supported by government initiative and how? Such control has immense implications for how local communities, local firms and transnational corporations can deliver national socio-economic benefits from intellectual property.

**Some future policy implications**

How might policy initiatives for supporting knowledge systems vary across different policy domains. A starting point is to recognise that a key objective is to strengthen institutional connections within systems. Three areas immediately stand out:

- promoting an innovative and creative industrial environment;
- promoting technological capability and quality; and
- strengthening modes and mechanisms for enabling links between institutions.

**Promoting an innovative and creative industrial environment**

What might this mean in practice? First it implies reducing risk. To the extent that the burden of risk for innovation might be shared, there is a parallel incentive to engage in creative investments. However, the extent to which risk should be shared is likely to be different for each domain. It is unlikely, for example, that national governments would or would even consider influencing the decisions of large transnational corporations to invest in product development. However, they may influence decisions, among the latter, as to national locations where they might do so. For small local firms it will be a very different matter. There are many ways that direct or indirect incentives might target specific industries or groups of industries in selected

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regions. A regional analysis will help target and evaluate the impact of such programs.

Another example concerns the streamlining of administrative procedures. In the transnational domain this may concern regulative requirements for establishing joint ventures. At the local domain is more likely to concern regulatory procedures for gaining access to R&D or export incentives. The important point however, is to take into account the different intentions of policy and potential impact at different levels.

In terms of IPR, the introduction of good management and enforcement procedures is likely to be high priority for encouraging transnational technology investments. Within the local domain, however, the main task might be to promote the registration of IP. This might be achieved by providing information about IPR procedures. It might also be promoted by providing legal advice or assistance for selected firms. At a legislative level, as we have argued elsewhere, there are ways of working within TRIPS to enhance national capabilities through local knowledge systems.9

Promoting technological capability and quality

Local, national and transnational policy domains suggest different national approaches for promoting technological capability. One of the obvious examples concerns technical training. At the national level public support for national programs for training within higher education and research institutions may be a high priority. But at the local level, there is likely to be a strong case for introducing firm based support for in-house training. In many countries there are examples of these two approaches being in conflict. For example, creating bonded scholarships for research institutions restricts rather than encourages the diffusion of technical know-how. Such approaches might strengthen institutions at the national level, but do little to strengthen capability building at local levels.

Export markets demand international quality. For local producers, entering export markets carries with it imperatives for quality management. At the local level policy it is therefore important to ensure that export incentives are matched with programs designed to enhance quality development and IPR management. The national level will be important for establishing institutional capabilities for this, but the local level can certainly provide a specific and important target.

Strengthening modes and mechanisms for enabling links between institutions.

The issues discussed above suggest that the links between organisations and institutions are as important as what it is that takes places within them. Many local systems of innovation are weak because they are ‘weakly institutionalised’.10 A key

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10 See Adam Holbrook, Lindsay Hughes and Judith Finch, ‘Characteristics of Innovation in a Non-metropolitan Area: The Okanagan Valley of British Columbia’, CPROST Report No. 9901, Simon Fraser University, September, 1999, Vancouver.
policy task is therefore to strengthen the mechanisms that enable closer interactions between national and local knowledge systems.

Technology extension services can be a valuable mechanism for diffusing ideas and know-how to local knowledge systems. However, it is not so much the knowledge itself that is important but the ‘institutionalised’ mechanism for linking research and development facilities to local systems of production. While the practice of extension services is quite well developed in agricultural production it’s application to industrial production systems has been far more sporadic and tentative.

Professor Tegart, in his presentation to this group, noted the way that cooperative research centres, involving universities, industry and public research institutes, are serving to generate closer institutional alliances for producing and diffusing knowledge. Evidence emerging from the United States and elsewhere, is showing a wide variety of models for successful collaboration. In recent evaluations, however, it is becoming clear that the most successful groups are those that strengthen alliances across local, national and international domains. 11

Although driven by global imperatives, national administrative and legislative bodies are key institutions for the control and management of IPR. At the local level, what is needed is information about how these institutions can serve to promote innovation and access to legal expertise to gain, rather than lose from the global trend.

It is already clear that intellectual property systems are intersecting with broader socio-economic changes in the production and utilisation of knowledge. An important issue for developing international competitiveness will be the extent to which national governments are able to align their own local level priorities and policies with trends in IPR legislation that are in essence beyond their control. Meanwhile, the management of innovation and knowledge diffusion for national competitiveness will remain a ‘tight-rope walk’ between the different experiences and industrial trajectories of local, national and transnational innovation systems. A clearer understanding of the dynamics operating in the local, national and international policy domains will assist this process.

Competitive advantage is created and sustained through highly localised processes. Differences in national economic structures, values, cultures, institutions and histories contribute profoundly to competitive success. The role of the home nation seems to be as strong or stronger than ever. While globalisation of competition might appear to make the nation less important, instead it seems to make it more so. With fewer impediments to trade to shelter uncompetitive domestic firms and industries, the home nation takes on growing significance because it is the source of the skills and technology that underpin competitive advantage.

Michael Porter, *The Competitive Advantage of nations*
<table>
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<tr>
<th>Asia-Pacific economy</th>
<th>Human resources</th>
<th>Scientific output</th>
<th>Patents Registered in the USA</th>
<th>R&amp;D expenditure on R&amp;D as a % of GDP: 1995</th>
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<tr>
<td></td>
<td>Scientist &amp; engineers per million pop.</td>
<td>World share of scientific publication output: 1990</td>
<td>1996</td>
<td>General expenditure on R&amp;D as a % of GDP: 1995</td>
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### Table 2: Selected S&T Indicators by Selected Regions in China

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<tr>
<th>Selected Regions</th>
<th>% GDP &amp; Rank 1997</th>
<th>% R&amp;D Exp. &amp; Rank 1995</th>
<th>% of all R&amp;D in region spent in Firms</th>
<th>% S&amp;E in R&amp;D &amp; Rank 1995</th>
<th>% S&amp;E in Industry &amp; Rank 1995</th>
<th>% Torch Invest. &amp; Rank 1996</th>
<th>% Spark Invest. &amp; Rank 1996</th>
<th>% Patents &amp; Rank 1985-7</th>
<th>% Science Pubs. 1996</th>
<th>% SOEs &amp; Rank 1996</th>
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<td>5.1 (6)</td>
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<td>3.4 (12)</td>
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<td>8.1 (3)</td>
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R&D Expenditure: China Statistical Yearbook, 1996  
Scientists and Engineers, and Torch and Spark Program: SSTC, China Science and Technology Indicators, 1996  
Publications: Documentation and Information Centre, Chinese Academy of Sciences, 1998  
Staff employed in SOE and TVEs: China Statistical Yearbook, 1997.*
Figure 2: The Role of IPR legislation and policy management in the diffusion of knowledge

Degree of Excludability

Basket of Innovation Policy Initiatives

- Trade Secret Laws
- Patent Laws
- Design Laws
- R&D Subsidies
- R&D Associations
- Training subsidies
- Export incentives

Degree of Externality

Extent of Knowledge Spillovers

Complete (100%)

None at all

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1 Adapted from Turpin T. and J. Innes, *Intellectual Property Legislation and Innovation in Asia-Pacific Economies*, 1999