National Innovation Systems and Multinational Corporations

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National innovation systems (NISs) are defined by their social, economic, and political results. Many actors, institutions and processes are present within a NIS. Strong innovation policies stemming from a particular NIS effectively bridges key actors together within the innovation system. The design (various forms of policy) and result (various types and typologies) of NISs vary greatly, especially when differences among firm behavior are so diverse worldwide. This adds to the complexity of the concept. Yet multinational corporations (MNCs), due to many reasons discussed below, aid in our understanding of how NIS function. Through this understanding policy-makers can better formulate innovation policies, even if NIS are becoming more international and ad-hoc in nature (Mowery and Oxley, 1995).

This paper proceeds as follows. The second section discusses the implications and defines “National Innovation Systems”. The third section brings MNCs into the discussion by overlaying their presence as international entities within NISs. This framework gives rise to the fourth section whereby the relationship between NISs and international innovation networks of MNCs is examined. The last section provides some conclusions, in particular the extent to which a more nuanced understanding of MNCs interaction with NISs might increase the abilities of all actors involved.

2. The National Innovation System in the context of the MNC

The historical mix of endogenous industries strongly influences the characteristics of a country's NIS (Nelson and Rosenberg, 1993; Vertova, 1998); likewise MNCs continually expand into many different NIS in order to expand their knowledge and technological base. The latter may steadily acquire evermore competencies as they continually operate within the same region or cluster, at first domestically then internationally. Understanding the innate mix of a country's resources, both material and human, represents the cornerstone of a successful MNC operating within a NIS. Enduring policies rest on this institutional coupling (Kline and Rosenberg, 1986; Nelson and Rosenberg, 1993). Thus, historical characteristics of a country along with past interactions with corporations helps define a particular National Innovation System.

Within these “systems” (Fagerberg, 2003; Porter, 1990) a variety of “actors” (Nelson and Roseberg 1993) are pertinent including policy-makers, business leaders, entrepreneurs, and financial professionals, though the system is more complex than simply its constituent parts. Nevertheless, a NIS draws upon these different actors to harness value-added benefits embedded within international knowledge flows. Knowledge flows are embedded in different parts of the global value chain. More value-added vectors inherently provide greater knowledge in regards to technological innovation. Though the nature of countries acquiring global knowledge flows is competitive, and increasing home
competitiveness usually increases knowledge-absorption, this process is not a zero-sum game. In fact all countries connected to a dynamic network of knowledge flows can mutually benefit (Cantwell and Molero, 2003). Fortuitous innovation policies can maximize NIS capacity to draw on and build specializations, which has a dual result of pulling in more MNCs and, hence, innovativeness. Increases in innovation, whether in a firm or within a country, have a multiplying effect on economic gains.

In the past it was reasoned national innovation systems should encourage or provide basic research funding on the grounds of economic efficiency (Arrow, 1962). Yet more recently it's clear basic research doesn't imply innovations, especially if innovations are conceived in the narrow sense as disruptive or radical, and might not provide economic efficiencies. This is especially evident if the interaction of MNCs with NISs is poorly understood. However, basic research can help build and maintain a country's General Purpose Technologies (GPTs), which can be considered the building blocks of the information economy (Cantwell and Kosmopoulou, 2002). GPTs might be created or updated through basic research, either in public or private institutions. Therefore the break with prior innovation theory requires a realignment of basic research, not with a radical innovation systems, but with supportive infrastructure able to create and assimilate modern GPTs. Countries can attract MNCs by maintaining a strong GPT- base in tandem with cross-industry technologies (Cantwell and Molero, 2003). GPTs are endowed with a natural tendency to increase inter and intra-industry linkages. This is even more enhanced by MNC deepening and widening, or penetrating markets both geographically and technologically.

The design of NIS can be misguided if policy-makers hold a misinformed understanding of innovation, especially the creation and transfer of connected innovations. Innovations are loosely delineated between radical and incremental. Radical innovations require robust support, sometimes from the government but also from a series of parallel incremental innovations both between and among firms (for example when electrical power-plants were first developed) (Fagerberg, 2003). Contrarily, incremental innovations oftentimes develop with supporting apparatus, and thus are more able to stand on their own two feet. As such, incremental innovations strongly correlate to GPTs.

3. The Role of the MNC

With the increasing preponderance of MNCs in tandem to their expansive presence throughout the world, NISs are finding it more difficult to strike the right balance between support for innovation and protection of innovative outgrowth. Supporting innovation systems, however, largely relies on the productivity of MNCs because they are responsible for the bulk of the world's innovations. This is certainly the case with the rapid expansion of technological innovations over the past half century. MNCs that increase the rate and speed of global technological innovation can be referred to as Multi-Technology Corporations (Cantwell and Vertova, 2004). Such MTCs have been able to position themselves strategically within centers of excellence in different clusters throughout the world, and through such strategic maneuvers they are able to take advantage of different access points and technologies within different NISs (Cantwell and Kosmopoulou, 2002).
Whereas in the past it was theorized MNCs sought out simply lowest per-unit costs ostensibly associated with cheap land, labor and capital, the technological revolution followed by the interaction of MNCs with NISs demonstrates this is not necessarily the case. The break with the past is particularly evident with technology-intensive industries which reveal MNCs (or MTCs), despite higher costs, continue to invest heavily in locations with location-specific competencies, skills, and institutions. This finding refutes the claim NIS's are gradually losing ground in an increasingly globalized world (Patel and Pavitt, 2000).

3.1 MNCs and Competence-building

As MNCs expand into localities their needs change based upon global demand and adjustments to local specifications. A MNC might at first develop a competence-exploiting (CE) satellite abroad, or a subsidiary with the explicit instruction to gather local know-how, and subsequently transfer this back to headquarters (Lundvall et al., 2002); alternatively a MNC could develop a subsidiary with a competence-creating (CC) mandate, usually implying the presence of greater autonomy (Cantwell, 2001). The transition from a CE to a CC subsidiary is measured by the direction of knowledge and technology flows. A CE subsidiary will source most technology and knowledge from its home base, but as it begins to receive a CC mandate from headquarters, it develops its own independent technologies and knowledge which are location-specific and often entirely new to the MNC. MNC knowledge-based and asset seeking tendencies are detected when a CE subsidiary receives a CC mandate, and thus begins to transfer new knowledge and innovations back to the firm (Cantwell and Vertova, 2004).

After slowly embedding itself within the local economy and culture, and with explicit direction from the MNC headquarters, a CE subsidiary morphs into a CC subsidiary. This is of course more desirable for the host country because once a subsidiary has a high degree of independence and has a CC mandate, technical innovations in products and processes occur more rapidly. CC subsidiaries develop stronger innovation networks rendering relationships that foster more innovations. The result is a rapid catch up process induced through greater knowledge and technological spillovers. This rapid catch-up is increasingly more available to countries able to intuitively position themselves within an important part of the global value chain within their specialization (OECD, 2000).

Two vectors exist in this value chain. One vector represents actual products or goods, while the other can be thought of as the knowledge-value chain. The most to gain, at least in the short run, is a position in the value chain that adds high-value to a product or process. Consequently this should also be where the highest added value exists in the knowledge value-chain. High value is evermore found in technological knowledge and know-how, or tacit knowledge amalgamated by collective learning, localized skills and organizational routines. These different forms of knowledge increase the likelihood of variegated benefits to the NIS, and further attract foreign MNCs. Stronger domestic firms also result as they absorb spillovers and gradually increase FDI into other countries several rungs down the ladder. After a certain degree of technological catch up knowledge transfers, knowledge-flows, science-technology linkages, cross licensing and technology transfers occur more rapidly from home to
subsidiary and vice versa (Cantwell 1993, 2000; Cantwell and Kosmopoulou, 2002), even though it is imperative to understand most MNCs will initially only transfer core competencies abroad (Patel and Pavitt 2000).

3.2 Absorptive capacity

Innovations are accepted and adopted quicker in some countries and slower in others (Maclaurin, 1953). This is due to national absorptive capacity defined as investments in the scientific and production labor force, along with trade and economic policies promoting competition among domestic firms (Cohen and Levintha, 1990; Mowery and Oxley, 1995). This capacity includes a broad array of skills reflecting the need to deal with the tacit (know-how) components of the transferred technology, as well as the frequent need to modify a foreign-sourced technology for domestic applications (Mowery and Oxley, 1995). A successful NIS can encourage MNC technology transfer and CC through a variety of incubative policies including a stable macroeconomic environment, transparent business law and a strong judicial system, along with formidable educational institutions, all of which inherently add to a nation's absorptive capacity.

3.3 Innovation and Institutional Environment

MNC usually do not rely on University research for most their innovations. Though scientists may link previous inventions together to arrive at a new innovation, this arduous process is evolutionary and collective (Nelson and Winter 1982). Meanwhile, MNCs are in the business of rapidly scaling up and selling innovative products and processes. This does not imply basic R&D in the form of federally funded Universities is unnecessary. MNCs will certainly run into difficulty innovating everything from the ground up, thus educational institutions must be properly connected across time and space. Universities build up evolutionary and incremental innovations over long periods of time, while they increasingly operate across borders evidenced by increasing rates of University research collaboration between different countries. Universities usually do not produce radical or even process innovations. The latter almost always occur within firms through long periods of learning-by-doing or reverse-engineering. However the former is well supported by a strong educational and institutional environment. Thus a strong science-research base and institutional guidance adds to the competence-creating potential and absorptive capacity of a certain country from the perspective of the MNC. These embedded skills, revealed by strong institutional support, demonstrate a country is capable of managing various forms of innovation and technologies. It is important to remember institutional capacity often evolves in tandem to MNCs and hence innovation capacity. Therefore an added benefit of allowing MNC's increased presence within a country is an organically created “catch-up” in the institutional sense, as local institutions must be created in order to accommodate the needs of MNCs and related technological spillovers.

However technological spillovers usually are not high-tech spillovers but rather part of the low-tech piece within the overall technological system (or GPTs). The evolutionary characteristics of NISs
are problematic for policymakers overly focused on shaping innovation systems within a short amount of time and through their own misguided innovation lens (Lundvall et al., 2002; Porter, 1990; Schumpeter, 1984). Oftentimes policymakers fail to comprehend the pivotal place MNCs play within the NIS, and do not time or adjust their policies accordingly. In some instances, after a country has effectively “caught-up” the same institutions which were absolutely imperative for the catch up process become bureaucratic stumbling blocks to the next phase of a country's economic and technological development. Such anemic institutions effectively stifle more value-creating activities (Lazonick, 1992). Institutions slow to react to changing technological environments impede the absorptive capacity of firms within their national borders. This paradigm is referred to as technological “lock-in” or “institutional sclerosis” which might prevent countries from specializing in the areas of the highest technological opportunities (Vertova, 1998). Meanwhile, if a country boasts many strong MNCs they are able to understand and in a sense transfer back to the home country, and NIS, the rapidly changing nature of the technological environments around the world.

4. Lessons for NIS from MNCs

MNCs depend on cross-border and cross-sectoral collaboration (Cantwell and Kosmopoulou, 2003). It is well known MNC products and operations extend around the world. Less often discussed is the extent to which MNCs mine the globe for technological assets through innovation networks, referred to as “geographically dispersed technology sourcing” (Cantwell and Molero, 2003). As policymakers become more interconnected and cognizant of such MNC pathologies (Cantwell and Kosmopoulo, 2003), a more comprehensive NIS may result. Openness is a key aspect to this process (Lall, 1997).

NIS openness applies to a nation's research base, its financial and banking institutions, as well as its political and institutional system. The interdependence and relationship of each is integral to the healthy operation of the NIS. An open research base allows research universities to connect with MNCs. Open finance facilitates domestic-inward-investment and FDI, a prerequisite for scaling up industries by value-creation. Lastly an open political system, in the sense of openness to change and limited control over industrial innovations, solidifies MNC trust as CE mandates evolve into CC subsidiaries. Openness in terms of financing, politics, and knowledge also serves to benefit a NIS because it avoids innovating everything from scratch. Open institutions enable a steady stream of innovative activities (sometimes wrongly assumed to be the result of technological leapfrogging). Distinct forms of openness are detected among US, Japanese, and European NIS. For example while the US is considered the most open, the Japanese NIS is the most interconnected, while the European system relies on structural change. MNCs surely understand these different institutional nuances. The question remains: do policy-makers understand this relationship?

5. Conclusion:

A proper understanding of NISs requires a robust analysis of a country's resources, path-
dependencies, history, financial and political systems, among other variables both present and future. Drawing conclusions from the analysis of such data is inherently difficult. Perhaps the arduous nature of such a task is the reason innovation systems are so often misunderstood. Yet innovation system research over the past two decades, particularly as in relation to technology and multinational corporations, pulls back the curtain on the innovation enigma, if only slightly. While policymakers make a decision to plant a field of wildflowers, the success of such an undertaking depends on the land chosen, the skilled people available to use technology in order to efficiently till the land, an effective fence to safeguard trampling from people or animals, the right amount of nature's water and sun, and the supply of healthy bees able to cross-pollinate the flowering field in order to create stronger and diverse new flowers. Hence policy is a small but integral part in catalyzing the innovative system, natural resources help determine trajectories for a particular geographical area, institutions are needed to guide the system, and MNCs supply pertinent breading, networking and innovating abilities.
Bibliography


