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Building Strength Through Knowledge Networks in Higher Education

서울대학교 교수 Lynn Ilon

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Lynn Ilon(Seoul National University)

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Ⅰ. Abstract

The paper discusses the underlying economic shifts that cause a paradigm shift in the way that higher education contributes to society's progress. In particular, the movement from industrial production towards a knowledge economy and from national systems of education toward global networks of learning has laid the foundation for this paradigm shift. The value of knowledge can now be generated from all sectors - not just industry. People own this value and transport it from job to job, from home to job into their civic life. The collective nature of networks means that knowledge changes rapidly and is cheaply distributed so that knowledge itself is cheap but is also quickly outdated. Learning continuously and being able to sort through the vast amounts of knowledge available are highly valued skills. Thus, a high quality university system is one that is a network of learning, knowledge sorting and innovation. Successful research is a matter of building collaborative research networks. The paper describes the nature of these networks, the latest research on such networks and the likely beginning points for building such higher education networks.

II. Building Strength through Knowledge Networks in Higher Education

Higher education has always derived its validity by its contribution the progress of its society. During an industrial age, this link was fairly straight forward. Societies made material progress when the value of raw materials could be added to by processing the raw materials in some fashion. Iron ore has value as a raw material. It has more value as processed steel but in order for a society to benefit from this added value, it must have skilled labor and engineers. Processed steel formed into finished automobiles has more value still but in order to manufacture automobiles, one must have even more advanced labor and engineers. Universities make many contributions to societies, but in an industrial age, one clear role was helping build industry by producing the skilled labor and thinkers needed to raise national incomes. Thus, since the age of industrialization, the role of universities has closely linked to increasing the value of what a given society can produce by its industry. The higher the skill level, the more value can be added to raw materials and the great gains can be added to the material wealth of a society.

That link is not so clear since knowledge began insert itself into the value of production. The value of a new automobile mobile has long passed the point when its material and labor costs were the primary source of its final value. Rather, most of the cost of a modern automobile is the knowledge incorporated in it. The design, microchips, marketing and customer service management are central to its success and the most expensive part of its manufacture and sales. Because these components are built from knowledge, they have peculiar characteristics. First, they need not be "built" at the same site as the automobile itself. Indeed, they can be built anywhere and assembled simultaneously and virtually. They are expensive to build (design, conceive) but, once built, can be used in every single vehicle again and again (the same logic applies to every car). The worker (computer chip designer, marketing expert,

etc.) does not leave the knowledge inside the factory, but rather takes it home to help her child with homework, help her church with the membership lists and help her political organization win the next election (in the form of additional understanding of social networks, computer skills, internet interface). And the worker does not have to live or work in any particular country.

These characteristics of knowledge and many of these peculiar characteristics mean that knowledge production acts entirely different, as an economic unit, from industrial production. It affects people' s lives in very different ways and affects societies in very different ways. Economists are only beginning to understand these differences (Cortright, 2001). While the role of universities may be more important than ever in a knowledge economy, it role as a singular producer of workers for industry is fading. Rather, value for society is being generated by all sectors directly by its people' s ability to use knowledge to create new ideas in complex ways. Raw knowledge is increasingly cheap and easily available through the internet. Universities are not needed to disperse raw knowledge, but are needed to organize and sort knowledge and to help people come together to collaborate to build complex ideas that cannot be built by individual thinkers. The new role of universities is that of a successful, dynamic network.

Universities have a long history and their link to society is not always obvious. Therefore, this article is intended to outline the recent shift that is occurring in the way that societies create value and how that, in turn has created a new environment for higher education. The article then describes the first evidence of this new environment. Finally, it suggests a way to begin to think about how to create this environment in the context of Korea.

III. Social Progress in a Knowledge Age

Universities validate themselves as being centers of learning, innovation and research. But how is this done in an age when the ways that societies create value is rapidly changing to a knowledge economy? It is worth noting that this is not the shift to knowledge production is not the first fundamental change in the way that societies create value. At one time, value was largely created through the ownership and control of land. People (or nations or kings) who owned and controlled land had the wealth and power in a society. This gave way to an era of industrialization. Then, one could actually have substantial wealth without owning any land. Instead, it was the ownership or control of industry that defined one's wealth and status. Now, individuals, nations and corporations may have wealth and status without owning either land or industry. Instead they may have control of knowledge or knowledge flows. The Times Higher Education University Rankings is a knowledge source with considerable power and influence but without land or industry, as an example.

One of the first problems faced by economists in a knowledge economy, was how to keep track of the value created by knowledge. If one can measure the value of knowledge produced within society, then one can know when a society is making progress. This in turn, could guide university policy, for a successful university system would add to this societal progress. But the problem has confounded economists and the exploration of the problem has actual led to some profound thinking about the nature of society by some very top thinkers and international organizations. In turn, it is likely to lay the foundation for higher educational institutions into the future.

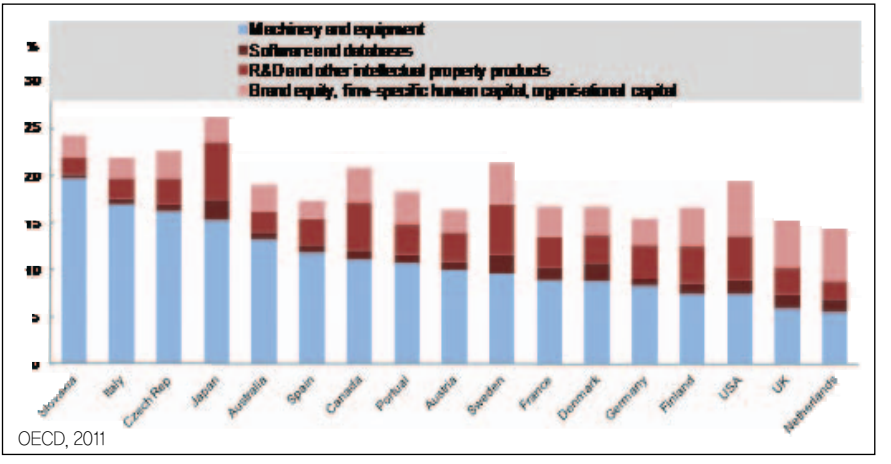
It is easy to view a nation's strength as permanently tied to its industrial output, but this has not always been the case and it will not be the case in the near future. During an era where land was the measure of a society's strength and wealth, a map kept track of valued waterways, natural resources and arable land. Any society could measure

whether is had gained or lost these fundamental sources of value. In an industrial era, keeping track of national gains or losses in national value required national accounting of industrial output. The measure of gross national product (GDP) summed up the value of all production within the country (compensating for imports and exports). If all businesses to a proper job of reporting their sales, then a country could determine if its value was increasing and whether its rate of increase was faster or slower than it neighboring countries. With a few more calculations, this value could be attributed to the education of each level of education within the country (Psacharopoulos, 1981).

The GDP calculation has not been without its critics throughout the years (Stiglitz, Sen, & Fitoussi, 2009) but, as a whole, the profession has had large agreement on the primary premise that GDP captures the value of industrial production in an economy and that education adds to that value in calculable and positive ways (Sobel, 1978) .

This is in sharp contrast to the era of knowledge economics. No one seems to know how to do this for knowledge productivity. Yet, as Table 1 shows, some countries are investing up to half of their new investment in knowledge-based investments. Their investments in traditional industries has shrunk to only half of their new asset investments.

Table 1: Investment in knowledge vs. traditional assets as a share of GDP, 2006



Even this OECD count is likely an undercount as it measures only the knowledge investments that actually can be measured in currency values and also only those that go through industries. In fact, economists know that neither of these definitions fully capture the full value of knowledge to societies. Capturing this fall value eludes economists at the moment. The problem lies in valuing the exchange of knowledge. Mirowski (2009) surveys three failed attempts to explain the value of knowledge and concludes that the inclusion of knowledge forces the profession to accept that neo-classical economics may have fundamental flaws that need to be discarded. Mirowski, concludes:

"Everyone seems to believe that knowledge is the key to economic success, and yet our most developed schools of economic thought are mired in the most frightful muddles when it comes to modeling knowledge in an economic setting." (Mirowski, 2009, p 144)

A new line of thinking has begun to take shape that does rethink neo-classical economics Romer (1993) addressing a meeting of the World Bank, suggested that it was the use of knowledge that advanced societies. His initial work has been substantially reworked, but many have begun to accept that traditional theories built around industrial economics and neo-classical thinking are no longer adequate to explain the phenomenon of knowledge economics, including human capital theory. Warsh (2007) tracks the difficult rise of the theory into its acceptance. Still, it has various names. Romer called it "endogenous growth theory" but other authors have used names such as "new growth theory" (Cortright, 2001), "knowledge economics" (Mirowski 2009; Warsh, 2007), and "the learning economy" (Lundvall & Johnson, 1994).

The question relevant to higher education is not whether knowledge' s contribution to society can be measured, per se, but whether higher education contribution to such

knowledge can be made and accounted for. Without a reasonable accounting of whether it is making a proper contribution in preparing both tomorrow's leaders and charting tomorrow's research, an important link between universities and society is lost. So, how is the value of knowledge captured? Some insights do exist and have very interesting implications for universities. A good example to use is Google.

When one uses Google, one gets its service for free. But, in fact, the service is not really for free. Google gives you information in exchange for information. You get their very best guess of what you are looking for on the web and they get your best guess (by what you choose as a selection of the many choices) of what you really wanted. From this they can improve their search engine for the future. In addition, they know your IP address, so they know which country you are in and, if you are currently logged into Google (gmail, google sites, etc.) they know your profile. So they may know your network of friends, your approximate age, gender, and other general information about you. They take this information and turn it into either advertisement revenue or development of products that they can later sell to others or to people like you.

It is worth millions, perhaps billions of dollars and has made Google the valuable company it is today - seemingly without charging users for its services. What appears to be a "free" service is really a knowledge exchange - the exchange of knowledge value that does not turn into a cash exchange. It does not go into a market so no one (including national accounting people or market accountant) knows the true value of what has been produced. It is not reflected in the OECD chart in Table 1, but it has true value for you, Google and for society. It was never counted in GDP of Korea or the U.S.

Two Nobel prize winning economist, Stigliz and Sen (Stiglitz, Sen and Fitoussi, 2009) studied this problem as a background for OECD's World Forum conference held in Busan, Korea in 2009 (OECD, 2009). Their conclusion was that societies could

no longer measure industrial output as a way of capturing the value created by a society. Rather, societies needed to measure their outcomes. Just as the change from land to industry require a shift of keeping maps to measuring GDP, society would now have to measuring something even more complex - its outcomes. This means the societies must agree on what a good society is and be able to measure its progress toward that goal (Giovannini, et.al , 2009). Then, all sectors can measure their contribution toward that goal.

Several characteristics of knowledge redefine the ways that higher education now links with society. Unlike the theory of human capital where knowledge is embedded in industry, knowledge is now embedded in people and moves with them across sectors and geographic space. Knowledge is expensive to "build" but free to duplicate and use collectively. It is dynamic and changes rapidly so, unlike a chair or road or refrigerator, it changes rapidly. Finally, in its most valuable form, it is built by many people who have different "pieces of the puzzle" who can build complex innovations, solutions or ideas collaboratively. Each of these characteristics have particular implications for higher education's role in a knowledge society and, therefore, requires some further exploration.

Ⅳ. Changing Learning Environment

Traditionally, higher educational institutions have been structured around two basic tenants of knowledge economics - first, that knowledge as costly to obtain, and second that that the source of knowledge was physical - a teacher or book. The fact that these sources were physical (and one was high skilled and educated) made them expensive. Only some people had access to them and at high cost. Books were treated as valuable commodities. Professors' offices are testament to how recent and alive these tenants are today - offices are still lined with professor's private collection of long-acquired private libraries of books.

But the digitizing if knowledge has changed the cost of knowledge. The latest facts, research, information and knowledge are often available easily on the web today. One need only have a smart phone to look up a word, find a new scientific discovery, discover a historical fact or get the latest political news. Knowledge is cheap. Physical proximity to the knowledge source is no longer needed. Modern professor's offices are becoming sparse - down to a computer and a few books. Most information is stored on the computer or is instantly available through the vast networks of the web.

Although students dutifully show up for lectures, in fact, much of the information can be acquired elsewhere. But the notion that easy, cheap access to knowledge puts professors out of business is naive. It simply raises the level of professor's knowledge transmission from knowledge transferor to knowledge organizer and learning manager. Essentially, it requires an even higher level of their expert skill set. Sawyer (2006) sees this as a shift away from teaching facts to teaching deep understanding. Much work is being done on this new approach to learning which are called "new learning sciences" (Sawyer, 2009).

Whereas knowledge is easily accessible through the web, it must be organized for learning. And learning facts is only one part of a good education. Some of this raw

knowledge[1] transfer can, indeed, be given to the web. Massachusetts Institute of Technology puts many of its lectures online (MITOPENCOURSEWARE, n.d.). The Khan Academy (Khan Academy, n.d.) is growing as a free delivery source for raw knowledge although it simply replaces the classroom lecture with an online lecture. Nevertheless, some view this type of online learning as advantageous because it can be viewed anytime and can be replayed when the learner needs to repeat a particular concept. Hanford (2012) documents how some professors are turning lecture time into this kind of deep learning experience while the content (raw knowledge) is delivered before the lecture period.

Professors of the future will be learning guides rather than fact deliverers. Only experts in a field can sort through the exponential growth of facts, information and data on the web and determine which is correct, current, useful and helpful to students. This means the professors need to be constantly sorting through the recent information that is available and organizing that information. Some examples of this already exist and organized syllabi are likely to be readily available on the web. But, more importantly, once the myriad of data has been sorted through, they will act as guides to help students become continuous learners. Without the skills of continuous learning, what students learn today will be outdated tomorrow.

1) I will use the term "raw knowledge" to mean the delivery of facts and information in the form of a lecture or expert source to the learner without a means of interaction. Many educators term this kind of learning as "rote learning."

V. Changing Research Environment

The research environment is going through and even more radical shift due to knowledge economics. This is because educated human are not simply additives to the industrial productive process but are now flexible, dynamic learners that will, throughout their lives learn and recombine their knowledge in a variety of ways to build new ideas in ways unforeseen when they were in university. Effectively, universities are training them to be continuous learners and to take their learning and knowledge skills into a world where they will carry their ability to learn, create and re-invent as the world changes around them. The value of their knowledge is "housed" within them- not given over to an industry per se.

This is in contrast to the old human capital view where education prepared you for a contribution which was largely predictable in a given industrial framework (Schultz, 1961). In order to be continuously productive in a dynamic, continuous changing world of innovation, one needs to learn to world in a networked research environment where ideas are constantly build using vast resources of knowledge and build using the thinking of others who have complementary skill sets.

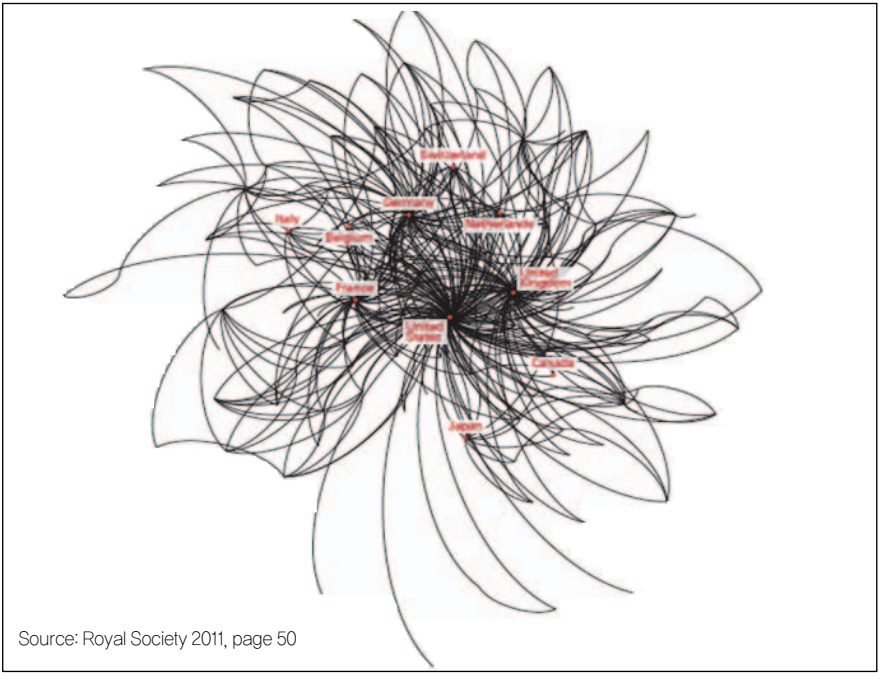
Essentially, universities are building the new national resource that fuels all sectors -diverse, creative thinkers. This change, from research for industry to building the research hub of creativity, appears to be subtle at first glance-perhaps even unimportant, but the change in research environments is profound. Sawyer (2009) derives his view of innovative teaching from his examination of how scientists turn knowledge into innovation. Collaboration is the key to innovation and is the frontier of much of the emerging work being done in this arena. Hidalgo and Hausmann (2008) new theory on economic growth show that growth occurs when there are a variety of people who have many different ways of thinking have the ability to combine their thinking into new, creative ideas- a network[2].

2) This theory combines two recent theories of economic development. It extends Romer's theory in that is acknowledges that it is people's ability to use their knowledge that builds value for society (Romer, 1993). It also uses Amartya Sen's Nobel winning theory on human capability (Sen, in that is says that is it the expansion of human capabilities that lies at the base of economic development.

This requires that universities think of themselves as networks rather than collectives of individual scholars or carefully segregated departments and colleges. Networks have a special set of characteristics that make them grow naturally and build new knowledge - it is known as collective adaptive systems (European Commission, 2009). Such systems build knowledge through many people contributing (collective) and such systems adapt to changing knowledge patterns (adaptive).

The Royal Society, England's oldest society of scientist's recently published a report entitlted "Knowledge, networks and nations: Global scientific collaboration in the 21st century" (The Royal Society, 2011). The report looked at universities as networks rather than as competitive, isolated institutions. It focused entirely collaborative networks of research. Figure 1 shows some of the centers of these collaborative networks. Not all are marked on the graph.

Figure 1: Global Academic Collaborative Networks – Various Centers Identified: 1996–2000



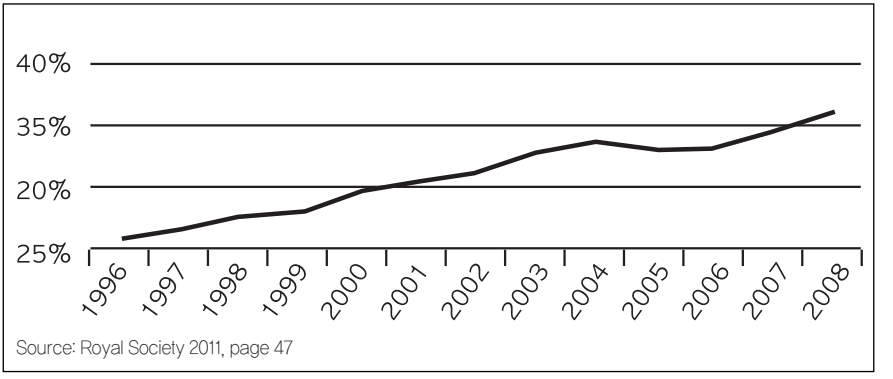
Source: Royal Society 2011, page 50

The question for universities is how to imagine themselves as central to these growing networks. The two characteristics of successful knowledge networks give us some clues. "Collective" in "collective adaptive" uses knowledge economics to reward network users because participation gives members rewards in knowledge gains (additional knowledge, partnerships, resources, etc.). "Adaptive" means that the network changes and grows (and thus becomes increasingly valuable to users) as people add new knowledge and implicitly teach the network how to organize the knowledge better. Google is a collective adaptive system, for example. Forcing people to use a system or designing a system that cannot change goes against the principles of knowledge economics, is not "collective adaptive" and is not a sustainable network system.

There are some good beginning points in Korean academia. Korea has very strong international linkages in academia. A large percentage of its professors have been educated outside of Korea. This gives them a built-in network of colleagues from other countries - a much higher percentage of international linkages than most other countries. Adams et. al. (Adams, Gurney & Marshall, 2007) found that a very large share of highly cited researchers had such international linkages. Of highly cited researchers based in the UK, for example, 45% had spent some time in another country during their research careers. Adams et. al. suggested that this type of linkage across countries and international research networks may be related: "The mobile populations of Switzerland and the Netherlands produce higher relative research performance for a small research economy." Bekhradnia and Sastry found that the most common reason given by the highly cited for moving was related to career development, followed by intellectual opportunities, with 80% of those moving judging that their career had strongly improved (Bekhradnia & Sastry, 2005). Mobility may lead to better international connections and hence to better collaborative research, which may overcome the constraints of smaller research economies." (Adams, Gurney & Marshall, 2007, p. 10)

The trend toward working with authors across international boundaries is increasingly rapidly. Partly this is because that many people are educated outside their own countries and have international ties. This may also be because technology is making such collaboration increasingly easy. But working against this trend is the growing competition for international professors. Table 2 shows the rise, over just a ten year period, in the publications with international authors. In this ten year period, there has been a ten percent rise[3].

Table 2: Increase in the proportion of papers produced with more than one international author 1996–2008



Source: Royal Society 2011, page 47

Foreign professors are part of an international network - to be combined with the already considerable international networks of Korean professors and the Korean diaspora. Also, foreign professors are part of a diaspora. Many foreign researchers maintained the overseas research links that they had established (OECD, 2008 P. 102). Hidalgo and Hausmann (2008) would argue that adding foreign professors adds to the innovative mix of a country and therefore adds to the country's innovative potential. Hart found that highly skilled immigrants can alter the institutions and organizations of the host country's innovation system and thereby increase its creative potential (Hart, 2007).

3) Appendix I shows that South Korea has risen to be one of the top internationally collaborative countries contributing to this trend.

VI. Conclusion

The most pressing challenge for higher education in the near future is a daunting one - reimagining itself. In the face of success through an industrial age, it now faces the task of changing its very premises as knowledge transmitter to one of knowledge hub - forgoing the comforting role of lecturer and taking on the new role of managing learning and collaboration.

The challenge derives from the rapid change in economics. In a matter of decades, value has become digitized and the new challenges are complex - requiring that a variety of people combine their knowledge to build complex solutions, ideas, products and approaches. These complex ideas and the knowledge that underlies them grow at exponential rates and are documented digitally for the world to absorb. Only collective, adaptive networks can handle such knowledge. Only large, collective, adaptive networks of experts, such as universities are positioned to handle this super highway of information.

Students can access the raw knowledge at any time. But professors are the guides to the raw knowledge rather than the sources. Which information to pay attention to, how to sort it out, how to learn at the pace of knowledge growth, how to build new ideas creatively and how to learn continuously is the job of the knowledge expert - the professor. At the same time, the university is the center of a vast hub of knowledge. Its internal sources of experts, its access to sources, databases, and its networks within the university, national and international are the foundation of its strength. Building, maintaining and strengthening this network is the source of its contribution and validity to society in a knowledge age.

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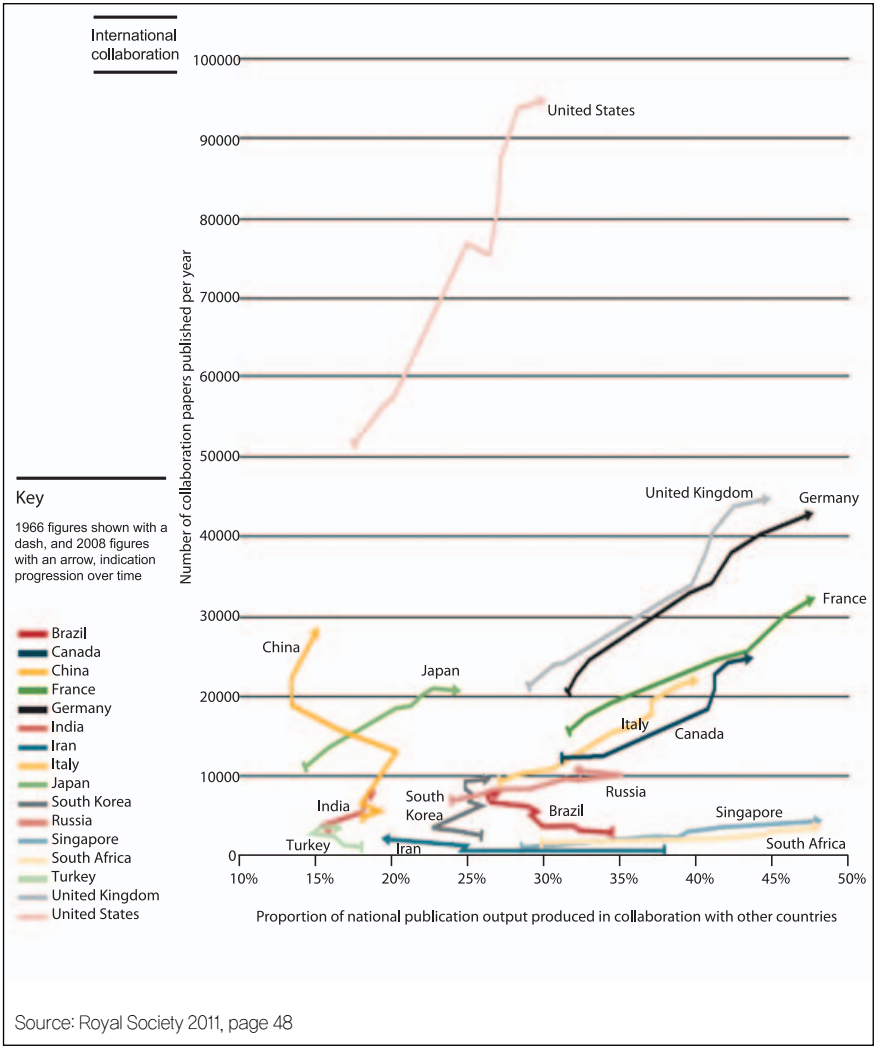
Appendix I: Growth of international collaboration for selected countries and the proportion of national output represented, 1996–2008



Source: Royal Society 2011, page 48

저자 소개*

Lynn Ilon

Lynn Ilon is a Professor in the College of Education, Seoul National University in South Korea. She teaches economic and systemic dimensions of global learning networks. Her interests lie in the intersection of global economics, learning and culture.

Her work centers on bringing disparate worlds together - economics & education, rich & poor, global & local. As such, her scholarly work centers on how education and learning links fundamentally bring human worlds together. Dr. Ilon holds degrees in Anthropology (B.A.), Educational Research (M.S.), Economics, (M.S.) and International Development Education (Ph.D.). She has lectured and consulted for the World Bank, Harvard University, the United Nations, Educational Testing Service, the U.S. Agency for International Development, Department for International Development (UK), the Asian Development Bank, the African Development Bank, UNESCO, several national governments and their agencies and several local and global NGOs.

Dr. Ilon has lived and worked in numerous countries including Jamaica, the former Soviet Union, Egypt, United States (lived and worked), Kuwait, South Korea (lived and worked), Nepal, Canada, France, Jordan (lived and worked), Bangladesh, Vietnam, Malawi, Zambia (lived and worked), Eritrea, Tunisia, Zimbabwe (lived and worked) Uganda, Micronesia (lived and worked) and South Africa. Her reports, scholarly work and invited lectures have dealt with several other countries