Governing the Global Knowledge Economy: Mind the Gap!

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Abstract

Globalization now extends beyond markets for goods and finance into markets for technology, knowledge workers, and innovation finance. This paper asserts the existence of a widening gap between the rapidly growing global knowledge economy and the woefully inadequate institutional framework that supports and regulates it. This gap threatens to undermine the potential gains and could slow or even stop the growth of the global knowledge economy in its tracks. In addition to describing key features of the emerging global knowledge economy, the paper highlights the *asymmetric* relationship between corporate strategy and government policy that results in the governance gap. We conclude with a preliminary discussion of design principles for bridging the governance gap and generic policy suggestions.

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0. Introduction

A restructuring of the innovation process is underway around the globe. New national and regional centers of knowledge work are emerging. As a result, global interactions, information flows, and knowledge sharing are accelerating, diversifying, and deepening. These changes have increased the pace of innovation and created opportunities for innovation in new locations. They rightfully evoke optimism, even utopian visions. It is expected that, once a place becomes part of the expanding global knowledge economy, it will have better chances to increase its share in productivity-enhancing innovation, high-wage jobs and economic growth.

The emergence of a global knowledge economy means that globalization now extends beyond markets for goods and finance into markets for technology, knowledge workers, and innovation finance[1]. An increasing division of labor in innovation has accelerated the creation of markets for disembodied (intangible) intellectual assets and for the skills and money needed to produce and use these assets effectively. The globalization of these markets is driven by fundamental changes in the economics of innovation and the resultant adjustments in corporate strategies and government policies.

[1] 'Knowledge workers' are defined to include science and engineering personnel, as well as managers and specialised professionals (in areas like marketing, legal services and industrial design) that provide essential support services to research, development and engineering.

Like other observers, we are optimistic about the potential of these developments to improve living standards and the quality of life of many millions, if not billions, around the world. Yet, the payoffs are not guaranteed. This paper asserts the existence of a widening gap between the rapidly growing global knowledge economy and the woefully inadequate institutional framework that supports and regulates it. This gap threatens to undermine the potential gains and could slow or even stop the growth of the global knowledge economy in its tracks.

The important point to emphasize is that these adjustments have been *asymmetric*. Corporate strategies shape the pace and contents of the global knowledge economy. Governments have been content to facilitate this process, while searching for ways to enhance local and national advantage. They have spent much less effort tackling broader issues of equity and economic sustainability.[2] The underlying assumption of policy has been that, similar to free trade, free markets for knowledge economy inputs will enhance global welfare. Yet, as Karl Polanyi concluded in his classic analysis of an earlier era of globalization, free markets can sow the seeds of their own demise. (Polanyi 1944) The emerging global knowledge economy will not thrive over the long term unless it is embedded within a supportive institutional framework of global governance[3].

The knowledge economy governance gap has not received sufficient attention in the literature on science, technology and innovation policy[4]. We know too little about what kind of

[2] The growth of the global knowledge economy also has important implications for environmental sustainability, cultural vitality, and moral principles (as in the case of human genetic engineerng). In this paper we leave aside these issues, critical as they are, in order to focus on political economy.

[3] Following Ruggie (2006, chapter 1: p.31), we define 'global governance as a combination of "treaty-based and customary international law, shared norms, institutions, and practices by which the international community as a whole seeks to manage its common affairs."

[4] An enormous amount has been written about global governance gaps in important policy areas, such as environmental and resource management, product safety, human rights, international security, and financial market

governance structures and processes might limit "systemic friction" that pits competing nations unproductively against each other. (Ostry, 199X:) We also need to explore how to better supply the global public goods upon which the knowledge economy rests. And, as in any market, there are externalities that are not accounted for by transacting parties, notably for our purposes externalities that may produce a backlash from those who perceive themselves to be losing out.

One public good that that the global community has begun supply to support the knowledge economy is intellectual property rights (IPR).[5] Protection of property rights is obviously a necessary element of the required institutional framework, but hardly sufficient, and, indeed, without complementary institutions, may be counterproductive. Thus far, debates have been dominated by concerns in the US, the EU and Japan on how to recreate their competitive edge. But this narrow focus may no longer be possible, as new entrants to the global knowledge economy are seeking to adjust the rules in their favor[6]. If no solutions are found to this conundrum, we may well witness a vicious circle of technological and scientific protectionism.

In short, it is time to study the challenges that the global knowledge economy poses for the governance of science and technology and the resultant distribution of opportunities for innovation. This paper is a think piece that seeks to outline a new research and policy agenda. We highlight imbalances in the forces that are widening, deepening and accelerating the globalization of the knowledge economy. We also emphasize the increasing diversity of actors who will seek to shape its governance. As a first step toward devising a governance framework ,

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regulation. Considerably less attention, however, has been devoted to governance gaps that could slow-down or derail the growth of the global knowledge economy.

[5] Governance processes organized for other purposes also bear on the global knowledge economy. Export control regimes, for instance, that aim to limit the proliferation of advanced weaponry, and restrictions on immigration, travel and communications that were introduced to fight the so-called 'war on terror' could stifle growth. Although not our focus here, these issues also warrant close attention from the global public policy community.

[6] China and India are the most prominent nations in this group, but the list includes both large countries like Russia, Brazil, Argentina, Mexico, South Africa, Indonesia, Egypt, Vietnam, and many smaller countries, like Korea, Taiwan, Malaysia, Singapore, Israel, the Gulf states, Poland, the Czech Republic, Hungary, and the Baltic states.

we seek to identify, for specific governance domains, conceptual building-blocks and generic policy suggestions. The evidence used to support our arguments draws on the authors' original research as well as secondary literature.

The first section of the paper describes key features of the emerging global knowledge economy. The next sections highlight the *asymmetric* nature of driving forces that result in the governance gap, confronting corporate strategies and government policies, and analyze the most pressing issues and the risks of non-action. The paper concludes with a discussion of objectives, design principles for bridging the governance gap, and generic policy suggestions.

1.0 The Rise of Global Innovation Networks

Only a decade ago, research on the geographical distribution of patents demonstrated that innovative activities of the world's largest firms were among the least internationalized of their functions (Patel and Pavitt 1991). This finding gave rise to the proposition that innovation, in contrast to most other stages of the value chain, is highly immobile: it remains tied to specific locations, despite a rapid geographic dispersion of markets, finance and production (e.g., Archibugi and Michie 1995). Attempts to explain such spatial stickiness of innovation have highlighted the dense exchange of knowledge (much of it tacit) between the users and producers of the resultant new technologies (e.g., Feldman et al.1999; Porter and Solvell 1998; Jaffe et. al. 2000).

Yet, even as this research was in progress, the world was changing, with the emergence of global innovation networks (GINs) in the 1990s and 2000s that carry out design and product development as well as applied and basic research. GINs share important characteristics with the global production networks (GPNs) that preceded them. (Ernst 2006). For instance, like GPNs,

GINs combine the geographic relocation of innovative activities ('offshoring') with increased reliance on external partners ('outsourcing'). (Feenstra 1998; Jones and Kierzskowski 2000). Similarly, most GINs, like most GPNs, involve lead firms ('flagships') that dominate control over network resources and decision-making. (Ernst, 2007a)

GINs help flagships to gain quick access to skills and capabilities at lower-cost overseas locations that complement the flagships' core competencies. As the flagship integrates geographically dispersed innovation clusters into GINs, this may well produce cost savings. Yet, the real benefits of globalization result from the dissemination and exchange of knowledge and complementary capabilities. Network flagships increasingly rely on the skills and knowledge of specialized foreign subsidiaries and suppliers to enhance their core competencies.

1.1. The Measurement Problem

There is a dearth of adequate data, indicators and methods to assess and analyze the internationalization of innovation. Samuel J. Palmisano, the IBM chairman and CEO, argues that, "ironically, the measurement of innovation is one of the least innovative of all our measurement systems." (Palmisano, 2007: p.5)[7]

Innovation statistics remain strongly focused on tangibles and technological innovation, neglecting intangible intellectual assets and innovation in services (Graham, 2007). In addition, most quantitative measures are lagging indicators (often by a number of years) and they fail to

[7] Existing measures have focused on the familiar easily countable inputs and outputs, such as trade and foreign direct investment in hi-tech industries, and the geographic distribution of R&D expenditures and personnel, patents and citations. Yet, as Albert Einstein observed: "Everything that can be counted does not necessarily count; everything that counts cannot necessarily be counted." (quoted in Calaprice, 2005).

trace the growing exchange of technology, information and knowledge across borders that are critical for most innovation projects[8].

Nevertheless, we can highlight a few proxy indicators. The scattering of the innovation process across borders, for example, shows up in IMF Balance of Payment data as a rapid growth of international payments for intangible intellectual property, especially technology licensing. A recent survey, to take another data point, shows that the world's leading R&D spenders are increasing both offshoring and outsourcing of innovation activities to Asia, especially to China and India (UNCTAD 2005).[9] By 2004 China had become the third most important location for overseas R&D affiliates, after the United States and the United Kingdom, followed by India (6th) and Singapore (9th). More than half of the responding firms have at least one R&D facility in China, India or Singapore.

The same survey projects that the pace of R&D internationalization will accelerate, especially among U.S., Japanese, and Korean headquartered firms. As many as 67 percent of the respondents to the UNCTAD survey stated that the share of foreign R&D will increase; only 2 percent indicated the opposite.

A third way to measure the rise of the global knowledge economy is to examine what happens to engineering jobs. A recent on-line survey of US electronics engineers, conducted by the respected *Electronic Engineering Times*, finds that 50% of US respondents (up from 46% in

[8] There are now attempts to improve the quality of collected innovation data. In the US, the Department of Commerce has established an Advisory Committee on "Measuring Innovation in the 21st Century". One notable initiative is that, in July 2003, the National Science Foundation, the Bureau of Economic Analysis, and the US Census Bureau have established a data sharing and data linkage project related to the globalization of industrial R&D. But so far the only result is that a feasibility study has established that the data reported by the different agencies are comparable and could be linked (Jankowski and Moris, 2007). Similar attempts by the European Commission are still at a very preliminary stage (as reported in ProInnoEurope, 2007)

[9]The UNCTAD sample consists of the first 300 firms of the R&D scoreboard of the 700 top worldwide R&D spenders, published by the UK Department of Trade and Industry. And a 2006 *Economist Intelligence Unit* survey of 300 senior executives of leading global corporations finds that India and China are the 2nd and 3rd most important offshore R&D location (after the US and ahead of the UK).

2005) report that their company has sent electronics design work offshore. And job security and unemployment are the dominant concern of US-based engineers (69% of respondents), together with offshore outsourcing (67%).

1.2. Qualitative Findings

Case studies of company-specific global innovation networks (GINs), in our view, provide a richer, more current, and more persuasive source of data than statistics. (e.g., Ernst, 2005). Take Intel as an example. Its U.S. labs in Santa Clara, Folsom and Austin remain primary locations for core technology development and applied research, while Haifa, Israel (established in 1974) is focused on processor research and Nishny Novgorod, Russia, on software development. Intel has established seven R&D labs in Asia (outside of Japan), and it is planning to expand rapidly both the number of labs and their headcounts. Bangalore, India, Intel's largest lab outside the United States, conducts leading-edge dual processor development. With a workforce of around 2700, management plans a substantial expansion in India, most likely in second-tier cities that have lower labor costs than Bangalore. In Shanghai, China, Intel has recently expanded its R&D team to focus on applied research to identify new applications for China and other emerging markets.

The offshoring done by global firms is complemented by outsourcing of some stages of innovation, especially those related to product development, to specialized suppliers. For instance, global brand leaders for laptops and handsets use design services provided by specialized contractors, the so-called 'original design manufacturers' (ODMs), mostly from

Taiwan, for new product development (Ernst, 2007 b) [10]. In addition, global system companies (like IBM) and integrated device manufacturers (like Intel) are outsourcing to Asian fabless design houses the development of specific design building blocks and design implementation services (Ernst 2005).

1.3. New Entrants from Asia

Over time, an increasing diversity of GINs has emerged, bringing together R&D teams from companies that drastically differ in size, business model, market power, location, and nationality. The flagship companies that control key resources and core technologies, and hence shape these networks, are still overwhelmingly from the US, Japan and the EU. However, there are also now network flagships from Asia (outside Japan), led by Korea's Samsung and Taiwan's Acer,[11] and companies from China and India are following close behind.

Take Huawei, China's leading telecommunications equipment producer, which has pursued a two-pronged strategy (Ernst and Naughton, 2007): it is building a variety of linkages and alliances with leading global industry players and universities, while concurrently establishing its own global innovation network. In fact, Huawei has developed a web of project-specific collaboration arrangements with major suppliers of core components, such as Siemens (as part of China's TD-SCDMA project), 3Com (with a focus on sales and joint product development), as well as Intel and Qualcomm. And Huawei's own global innovation network now includes, in addition to six R&D centers in China, five major overseas R&D centers in the

[10] ODMs either implement a detailed set of design specifications provided by a global brand leader or they provide their proprietary integrated 'turnkey' solution to basic performance parameters requested by the brand leader.
[11] On Korean overseas R&D, see Youngsoo Kim (2000), Sachwald (2001) and Ernst (1994). For Taiwanese firms, see Chen, 2002 and Ernst, 2001.

US (Plano/Texas and San Jose/California), Sweden (Kista/Stockholm), Moscow and the UK (as part of British Telecom's list of eight preferred suppliers for the overhaul of its UK fixed-line phone network).

1.4 Mini-GINs

Finally, an important new development is that smaller U.S.-based high-tech companies, and even start-ups, are facing considerable pressure to engage in innovation offshoring. In fact, venture capitalists in Silicon Valley now require start-ups to present an "offshore outsourcing" plan as a precondition for receiving funding. The emerging business model is to keep strategic management functions like customer relations and marketing, finance, and business development in Silicon Valley, while increasingly moving product development and research work to offshore locations.

This shift has given rise to new models of innovation offshoring that frequently involve foreign-born engineers from Taiwan, China, and India. A typical example is a start-up company in Shangdi Information Industrial Base in Beijing's Haidian District that specializes in mixed-signal chip design (Ernst, 2007c). Chinese engineers who hold Ph.D. degrees from leading U.S. universities and have worked as senior project managers in leading U.S. semiconductor companies founded the company. It has received venture capital funding for developing chip designs in both China and Silicon Valley[12].

Multinational open-source technology development networks comprised primarily of individuals represent the most extreme version of this phenomenon. A small team lies at the

[12] A fully integrated design team in Beijing develops decoder chips customized for the new Chinese AVS (audio-video signal) standard. Of the more than 60 engineers at the Beijing facility, 90 percent hold at least Masters degrees. Five senior managers based in Santa Clara handle customer relations and provide design building blocks and tool vendors for design automation, testing, and verification.

core of such a network, mediating interaction, setting the agenda, and exercising quality control judgments. Collaborators pitch in with varying degrees of frequency and intensity. Such networks are "born global," in some respects freed from the constraints of geography altogether. (Weber)

1.5. A New World

The upshot of these developments is that, instead of a few pre-eminent centers of innovation, like Silicon Valley, there are now multiple locations for innovation, and even lower-order or less developed centers can still be sources of innovation (Cantwell 1995: 172). This is true for instance for materials, especially nano-science, where China is emerging as a new global center of excellence[13]. China is also emerging as an important player in analytical chemistry, rice genomics and stem cell biology. And India's bright spots include pharma, biotech and bio-informatics, as well as software and chip design. (Ernst 2005a).

We believe that the emergence of GINs represents an early phase in the creation of a much more deeply integrated global knowledge economy that could continue to expand rapidly in size and scope for many decades to come. However, the entrance of new players into the game, whether firms, regions, or countries, is creating new challenges to the incumbent leaders and the rules that they have played by.

[13] China ranks 3rd (after US and Japan) in the number of nanotech publications (Ernst, 2007d). And the Chinese Academy of Science is ranked fourth for nano-science citations (after UC Berkeley, MIT and IBM).

2.0 Forces Driving the Globalization of Innovation

The rapid pace of internationalization of innovation is driven by fundamental changes in the economics of innovation made possible by the digital revolution and liberalization. In this new context, corporate strategists seek to reconcile the growing cost, complexity and uncertainty of innovation and its shorter product-life-cycles with pervasive return-on-investment pressures. Corporations internationalize their R&D and construct global innovation networks in order to recruit lower-cost knowledge workers and to exploit their intellectual property as a tool for penetrating new growth markets.

2.1 Enabling Factors: Digitalization and Liberalization

Another way to describe the shift in corporate strategy is that there has been a rebalancing of the 'centripetal' forces that keep innovation tied to specific locations and the 'centrifugal' forces that place a premium on geographical dispersion. The latter have become more powerful, although the former have hardly disappeared. There are two root causes of this rebalancing: (1) the improvement of the information and communication infrastructure and its extension around the world, and (2) the liberalization of international economic policies that allows this technological change to be exploited more fully by firms and organizational networks.

Information and communication technologies provide effective mechanisms for constructing flexible arrangements that can link together and coordinate economic transactions among geographically dispersed locations. (Ernst, 2003). IT-enabled network management reduces the cost of communication, helps to codify knowledge through software tools and data bases, enables remote control, and facilitates exchange of tacit knowledge through audio-visual

media. Better, faster communication networks substantially reduce the friction of time and space not only for sales and production, but also for R&D and other innovative activities. IT-enabled network management has facilitated the exchange of knowledge among diverse communities at distant locations who work together on innovation projects.

Liberalization has also acted as a powerful catalyst for the expansion of global innovation networks by reducing constraints on the organizational and geographical mobility of innovation. Liberalization includes four main elements: trade, capital flows, foreign direct investment (FDI), and privatization. These different forms of liberalization hang together. Trade liberalization typically sparks an expansion of trade and FDI, which, in turn, increases demand for cross-border capital flows. This increases pressure for liberalization of capital markets, which forces more and more countries to open their capital accounts. This also encourages liberalization of FDI and privatization tournaments.

The overall effect of liberalization has been to reduce the cost and risks of international transactions, including those that involve R&D and other innovative activities. Global corporations have benefited most. Liberalization provides them with better access to external resources and capabilities that they may need to complement their core competencies. It also expands their range of choices for market entry, be it via trade, licensing, subcontracting, and franchising.

2.2 Corporate Strategy and "Knowledge Push"

Even as they enable global corporations generally, digitalization and liberalization complicate corporate strategy by bringing new competitors into play. In almost any industry, competition now cuts across national borders (Porter, 1990). To survive and grow, a firm must

be present in all major growth markets. It must also integrate its activities on a worldwide scale in order to exploit and coordinate linkages between these different locations. In addition, competition cuts across sector boundaries and market segments. Mutual raiding of established market segment fiefdoms has become the norm, making it more difficult for firms to identify market niches and to grow with them.

No firm, not even a global market leader like IBM, can mobilize internally all the diverse resources, capabilities, and bodies of knowledge that are necessary to cope with these challenges. The situation imposes two imperatives on such firms. They must take full advantage of the knowledge that they generate internally. For instance, they often elect to license technology and, hence, enhance the rents from innovation[14]. There are also strong pressures to reduce in-house basic and applied research and to focus primarily on product development (e.g., Chesbrough 2003).

Second, they have to absorb external knowledge effectively, not just domestically but on a global basis. (Ernst 2002). As demonstrated by Iansiti and West (1997), global markets for technology imply that a company can leverage basic or generic technologies developed elsewhere.

The result is that global innovation networks cut across firm boundaries, sectors and national borders. According to the *Science and Engineering Indicators 2004* report by the U.S. National Science Board, "the speed, complexity, and multidisciplinary nature of scientific research, coupled with the increased relevance of science and the demands of a globally competitive environment, have … encouraged an innovation system increasingly characterized

[14] The underlying assumption is that once markets for technology exist, one can codify knowledge sufficiently and develop well-defined and protective intellectual property rights (e.g., Kogut and Zander 1993). However, an excessive reliance on technology licensing may be risky because it cuts off the company from vital system integration knowledge that it needs for continuous innovation (e.g., Grindley and Teece 1997).

by networking and feedback among R&D performers, technology users, and their suppliers and across industries and national boundaries." (National Science Board, 2004, Volume I, page IV-36).

2.3 The Market for Knowledge Workers

Liberalization has also fostered a selective globalization of markets for knowledge workers. Until the turn of the century, the United States was the main beneficiary of the globalization of knowledge workers.[15] In the past few years, global corporations responded to the intensifying competition for scarce global talent by moving R&D and engineering overseas, especially to populous countries like China and India that have emerged as important new sources of lower-cost S&E students and workers. For many US high-tech companies, global sourcing for knowledge workers now is as important as global manufacturing and supply chain strategies. The goal is to diversify and optimize a company's human capital portfolio through aggressive recruitment in global labor markets.

Highly skilled knowledge workers are much cheaper in Asia (outside of Japan) than in the United States. For instance, the cost of employing a chip design engineer in Asia is typically between 10 to 20 percent of the cost in Silicon Valley (Ernst, 2005).[16] As coordinating cross-continental design teams is likely to add substantial costs, industry experts estimate the net advantage to be between 30 and 50 percent. Cost savings of such magnitude obviously are of

[15] A 1998 NSF study showed that more than 50 percent of the post-doctoral students at MIT and Stanford were not U.S. citizens and that more than 30 percent of computer professionals in Silicon Valley were born outside the United States (quoted in National Science Board 2004). Data from the 2000 U.S. Census show that in science and engineering occupations, approximately 17 percent of bachelor's degree holders, 29 percent of master's degree holders, and 38 percent of doctorate holders were foreign born.

[16] This cost comparison includes salary, benefits, equipment, office space and other infrastructure.

quite significant importance for companies that are under constant pressure to improve their return-on-investment, and provide an important incentive for innovation offshoring.

Asia's leading electronics exporting countries have helped encourage this strategy by substantially expanding their higher education systems and the high-technology sectors of their economies in an effort to develop internationally competitive centers of excellence Take China - with $136 billion, China is now the world's second largest R&D investor, after the US (with $ 338 billion), but ahead of Japan ($ 129 billion)17. Since 1991, China's R&D expenditures grew more than eleven-fold (or more than 20% annually, much faster than the annual growth of US R&D of 4.5%).

The result has been a massive growth in the supply of knowledge workers. While in the past, Asia's emerging economies "have been the main source of internationally mobile scientific and technical talent, but recently some of them have developed programs designed to retain their highly trained personnel and to even attract people from abroad". (National Science Board 2004: chapter 1, overview, p.8),

For instance, China now graduates almost four times as many engineers as the United States. South Korea – with one-sixth of the population and one-twentieth of the GDP – graduates nearly the same number of engineers as the United States (National Science Board 2004, Appendix 2-33). And China is experiencing explosive growth in Ph.D.-level degrees in science and engineering, the critical indicator of a country's research capabilities[18]. Such rapid expansion has undoubtedly come at the cost of a declining quality of graduate education, at least

[18] A recent report prepared for the National Bureau of Economic Research shows that between 1995 and 2003, first-year entrants in science and engineering Ph.D. programs in China increased six-fold, from 8,139 to 48,740. The report concludes that "… (a)t this rate China will produce more S&E doctorates than the United States by 2010!" (Freeman 2005: 4).

outside a handful of elite universities[19]. But there are signs that the quality problem is being addressed aggressively[20].

For certain "bottleneck skills," such as experienced design engineers for analog integrated circuits, these trends have led to global "auction markets." These "auctions" enable knowledge workers to sell their talents to the highest bidder. Overall, however, the emergence of a global market for knowledge workers seems to have kept a tight cap on increases in remuneration (Lazonick 2005). Leading global corporations can tap into markets for workers who are readily available for hire and need not require extensive internal training or the inducement of lifelong employment. In addition, corporate strategists have become adept at finding new lower-cost sites for knowledge work, such as lower-tier cities in China and India, or new locations in Vietnam, Romania, Armenia and Slovakia.

[19] A recent McKinsey report argues that, if all negative factors are factored in, only 25 % of India's engineering graduates are suitable for work at global corporations, while the current share in China is only 10% (Farrel, Laboissiere, and Rosenfeld, 2005). This report defines "young professionals" as university graduates with up to seven years of work experience, and includes engineers, finance and accounting specialists, generalist professionals, life science researchers, and quantitative analysts.

[20] The McKinsey report shows that the current supply of suitable engineers in low-wage countries represents as much as three quarters of the suitable engineering talent pool in higher-wage countries. This share is substantially higher than the 44% share of low-wage countries in the total supply of suitable young professionals in higher-income countries. Furthermore, the supply of suitable young engineers is expected to grow much faster in low-wage countries than in higher- wage countries. McKinsey projects tohat by 2008, low-wage countries will supply the same number of suitable young engineers than in high-wage countries.

2.4 Finance

Selective globalization is also an apt description of innovation finance in the early 21st century. The R&D management functions of globally integrated corporations not only allow innovation projects in diverse countries to be coordinated – they also put them into competition with one another. These players allocate R&D funding with less geographical constraint than they used to, as the UNCTAD survey cited above illustrates.

Venture capital has started to go global as well. Although the US still remains by far its primary beneficiary, more and more Silicon Valley venture capitalists are opening offices not only in Europe, but also in new places like Mumbai, Beijing, Hong Kong, Singapore, Taipei and Seoul. According to one of Silicon Valley's best-known venture capitalists, "We see innovation all over the world. We don't just want to sit here in Silicon Valley, only making investments in companies we can drive to."[21]

The main attractions are China and India. *Business Week* headlines are a good barometer for China's rise as a VC market: from "Venture Capitalists catch China Fever" (March 22, 2004) the temperature rose to "Venture Capital's New Promised Land" (January 16, 2006).

Ernst & Young's *Global Venture Capital Report 2007* provides some numbers to support the headlines. In 2006, venture capitalists invested almost $2 billion in China, a growth rate of 58%. Growth continued into the second quarter of 2007, with twelve new funds raising a total of $ 2.36 billion (Zero2IPO, 2007). Foreign VC funds (primarily from the US but also from Taiwan) continue to play the key role, representing 89% of the total VC investment in China during that period.

[21] Don Wood, managing director of Draper Fisher Jurvetson (DFJ), quoted in "DFJ to acquire stake in Esprit", *Financial Times*, August 6, 2007

Although venture capital is typically seen as a quintessentially private activity, it is undergirded by an institutional framework with critical public elements. In the U.S., a series of regulatory and legislative changes in the 1970s vastly expanded the range of potential investors and the pool of funds that the industry could tap into. (Lazonick 2005: 23). Venture capital also requires a pool of high-tech entrepreneurs who, in addition to being financially savvy, are able to provide hands-on start-up experience, built up over time. Some of the institutional arrangements that have fostered the U.S. venture capital industry are now gradually being constructed in other places, including China and India. If they take hold, the globalization of innovation finance will accelerate.

However, there are strong incentives for governments to seek to take short-cuts as they compete for the favor of globally footloose venture capitalists. Such policies are symptoms of a broader race to enhance national competitiveness that make global governance of the knowledge economy more imperative.

3.0 The Governance Gap

Enabled by digitalization and liberalization, corporate strategies largely shape the pace and contents of the global knowledge economy. That is not to say that the state has withered away. (Rodrik, 1999; Hart, 2005; OECD, 2007) We should, of course, remember that public policy has played and continues to play a leading role in both digitalization and liberalization. More important for this paper, nations (and, in many places, provinces and localities, too) have undertaken a variety of policies intended to recruit knowledge economy assets, such as venture capital, from abroad and to jumpstart indigenous development. (Ostry and Nelson, 1995; Ernst and O'Connor, 1989).

These interactions among organizations and places have the potential to induce many positive feedback effects, expanding educational investment, accelerating legal and financial reform, and speeding the development of infrastructure, as well as pushing the pace and expanding the scope of innovation. But such effects are not automatic. Global competition involves potentially pathological asymmetries that must be recognized and controlled in order for the positive dynamic to be unleashed.

In this section, we highlight three kinds of pathologies: coordination problems, public goods shortfalls, and potentially destabilizing externalities. In devising a governance framework to redress them in the domains of codified knowledge, high-skill migration, and innovation finance, we seek, as John Ruggie puts it, "to reconcile the efficiency of markets with the values of social community that markets themselves require in order to survive and thrive." (Ruggie, forthcoming: p1)

3.1 Triple Threat: Neo-Techno-Nationalism, Orphan Public Goods, and Backlash

Coordination problems are direct results of competing national policies to reap the benefits of liberalization. In essence, these are classic "races to the bottom," although they are manifested somewhat differently in the knowledge economy domains than in other issue areas. The challenges are well enough known that WTO rules and EU competition policies seek to restrict the scope of policies such as investment subsidies and favoritism in government procurement. Yet, as the examples of the small Nordic countries and the Netherlands demonstrate, the scope for neo-techo-nationalism in a liberal regime is far greater than commonly assumed.[22]

[22] Following Yamada (2000), we call such policies 'neo-techno-nationalism', to indicate that they are hybrids that combine elements of the widely discussed *ideal types* of 'techno-nationalism' and 'techno-globalism'.

One important difference between the neo-technonationalism of today and its precursor in the 1980s is the significance of the developing countries (above all, China)[23] as end markets for high-tech products, especially in wireless technologies. The strategic need for global firms to have access to emerging markets gives their governments some leverage over the location of innovation-oriented activities, which may intensify conflict with advanced countries that seek to rely on high-tech exports. U.S.-based firms, for instance, have argued that the Chinese government has sought to use discriminatory taxes to promote domestic semiconductor production and biased technical standards to encourage domestic wireless local area network (LAN) equipment makers.

Shortages of global public goods are somewhat more obscure, since they are the products of omission rather than commission. Competition in some spheres of activity crowds out effort in others. The most obvious governance gap of this type relates to the generation of scientific knowledge in the public domain. Without a mechanism to ensure that adequate benefits from public goods will flow to those who provide them, some goods – such as scientific knowledge – that would benefit all players in the global knowledge economy wind up orphaned. Although this problem has also been recognized, the responses to it are often so burdened with transaction costs that they are ineffective.

Externalities that accompany the emergence of the global knowledge economy have the potential to spark a backlash that echoes that described by Polanyi in previous centuries. "Creative destruction," as Joseph Schumpeter famously characterized technological and organizational innovation under capitalism, imposes costs on some groups, organizations, and

[23] In the electronics industry, for instance, China has become the second largest importer (up from seventh in 2000), and it is now the main export market for the United States, Japan, Taiwan and Korea. In addition, China is the world's largest market for telecommunications equipment (wired and wireless), as well as a test bed for advanced wireless communication and digital consumer systems. As most of that equipment is produced in China, the country has become the world's third largest market for semiconductors.

places even as it rewards others; neither the creativity nor the destruction are evenly distributed. If the global community can recognize and ameliorate these costs – or better yet, anticipate them and help those bearing them to adapt, the interests of both equity and economic sustainability will be served.[24]

3.2 Governance Challenges and Codified Knowledge

Intellectual property rights, the policy area in which global governance of the knowledge economy is furthest developed, provides a good example of the opportunity and the threat held by this new stage of development. The globalization of markets promises to expand the reward from investments in new ideas. A new mousetrap can catch mice on every continent, rather than just those in the neighborhood. This potential payoff is all the more alluring when the costs of expanding production to reach new markets are relatively low compared to the costs of development (or virtually zero as in the case of software). However, the threat of imitation may be an equally powerful deterrent to risking money, time, and energy on such ventures. In a world in which technological capabilities are widely diffused, potential imitators lurk everywhere, sapping away the reward.

A global system of IPRs is necessary to solve this "appropriability problem." Such a system would need to raise the cost of imitation, but also provide mechanisms that allow some of the benefits of new knowledge to be shared. Unfortunately, the TRIPS agreement does not set this balance fairly. It resulted largely from the concerted pressure of pharmaceutical, communications and entertainment companies from the US, the EU and Japan, and its benefits have been skewed in their direction. Even the big players among the emerging knowledge

[24] As we noted above, we neglect externalities that impinge on environmental sustainability, cultural vitality, and moral principles in this paper that are very important to a broader understanding of globalization.

economies, like China, India, Russia and Brazil, generally lack the relevant expertise and the administrative capacity to take advantage of the limited opportunities that TRIPS provides.

As a recent study concludes, the TRIPS-based governance scheme "may hinder or prevent catch-up strategies, thus locking poorer countries even more firmly into a low-technology, low-value-added growth path and furthering widening the knowledge divide between those countries and developed countries." (UNCTAD, 2007:p.101. See also Granstrand, 2004: 275; Maskus 2000: 12) What's worse, regional and bilateral free trade agreements, often with even more stringent IPR provisions, have proliferated. And, international standards have become a strategic weapon in global competition, specifically to foster a country's IPR portfolio. (Suttmeier, Yao, Tan, 2006:3) In short, the governance set in motion by the WTO agreement is not even the best feasible global governance mechanism for IPR, much less one that approximates an ideal.

IPRs, in any case, solve only part of the appropriability problem facing potential producers of codified knowledge. Only certain valuable ideas can be protected as intellectual property – in the case of patent law, those that have been "reduced to practice." Ideas that are theoretical or which do not comprise a discrete invention or complete work may be appropriated by other users for their own gain without fear of being sued. A different kind of reward system has evolved in many such cases, one that relies on prestige rather than money. Scientists, for instance, admire the "beauty" of one another's experiments and give prizes to the most original thinkers. A knowledge producer's claim to the respect of her peers depends on her willingness to freely reveal what she knows and, often, to do so promptly.

Unfortunately, prestige doesn't pay the bills. This "solution" to the appropriablity problem depends on external patrons who do pay the bills. In the eighteenth and nineteenth

centuries, wealthy individuals, who were themselves great admirers of the knowledge producers (or who gained prestige in their own circles by being perceived as such), were the dominant patrons. In the twentieth century, the state took over this role to a great extent. While the element of prestige did not disappear during this transition – nations, after all, often wish to be admired by their peers – its importance diminished. An alternative justification bearing more than a passing resemblance to the one for IPR was put forward. A nation could rationally subsidize knowledge production by some of its citizens because the rest of its citizens would ultimately use that knowledge to the benefit of all.

In a world in which codified knowledge is instantaneously and simultaneously available to everyone in the world, however, this rationale crumbles. Just as potential investors may be deterred by the possibility of imitation in the absence of IPR, national budget-makers may be deterred from supporting scientists by the possibility of "free-riding" or "cream-skimming" by foreign firms (or governments). Such considerations have led states to reconsider their support for basic scientific research. This challenge might warrant the development of a global governance mechanism designed to enhance confidence that those who are benefiting from investments in basic scientific knowledge are also contributing their share.

Although the deterrent effect of "free-riding" is the most obvious global governance challenge impinging on flows of codified knowledge, it is not the only one. Ironically, the absence of global governance can spark wasteful public spending in certain fields, even as it reduces investments in others. The basic dynamic is the same one that inspires "patent races." In very hot high-technology fields, competing nations may perceive a "winner-take-all" situation, in which they expect value to be appropriated from knowledge only by the first to

create it. The result is duplication of effort, imprudent "crash" programs, and even outright fraud, as in the South Korean stem cell case.

The "winner-take-all" expectation may have some basis to it, since regional agglomerations of technological capability often do arise. Yet, the race to invest often extends far beyond its plausible regional or national winners. Political leaders in unlikely locales find such investments difficult to resist. They gain immediate public support through their association with high technology, while the political costs of wasted investments are deferred past the end of their terms of office or simply ignored. The damage may be compounded by indirect subsidies or by the extension of IPR or other forms of protection into these same fields.

In an ungoverned global knowledge economy, then, the coordination and public goods problems are likely to yield a highly unbalanced portfolio of national (and regional and corporate) investments in science. Some fields will be orphaned due to an inability to cooperate, even though the global net benefit of investments in them would be positive. Others will be crowded with pretenders jostling for advantage, most of whom will be wasting their money.

3.3 High-Skill Migration Beyond the Brain Drain

Much of the knowledge that serves as the fuel for the global knowledge economy resides in people, rather than on paper. The mobility of this tacit knowledge, like that of codified knowledge, is increasing. To be sure, highly-skilled and highly-educated people remain significantly more constrained by borders (and by choice) than other key assets in the global knowledge economy (like codified knowledge and financial capital), but they are moving more frequently and in more directions than ever before. These moves occur both within an organizational context, as firms shift personnel among locations and academic institutions

exchange students and scholars, and outside such a context, as individuals seek to improve their lives on their own.

Because knowledge typically takes a long time for individuals to learn, the size of the global talent pool (and any field-specific portion of it) is fixed in the short run. The desire of countries (and companies) to meet perceived short-term needs, or to stockpile talent for the future, drives them to offer talented people increasingly better deals, not only financially but in terms of legal and social status. Many OECD countries have expanded their quotas of highly-skilled immigrants in recent years and allowed these immigrants more rights and privileges, including in many cases full citizenship. Source countries that seek to retain would-be emigrants, or to induce them to return to their original homes, counter with attractive packages of their own. (Kapur and McHale 2005)

This competition constitutes an important coordination problem, but not one that can simply be captured by the conception of an inequitable "brain drain" from countries that offer poor deals to those that offer better ones. The framing of the problem as a "brain drain" invokes two assumptions that may prove false under certain conditions. One is that the benefits generated by highly-skilled migrants in the short run must accrue only to their destination countries. The second is that the global talent pool is fixed in size in the long-run as well as the short-run. The challenge to global governance is to create conditions that prove these assumptions wrong, rather than to try to directly allocate highly-skilled labor, restrict flows of people, or compensate the source countries.

The distribution of the benefits of international migration by knowledge workers in the short run depends much more than it used to on the organizational context within which the migration occurs. Those who move across national borders but remain within the organizational

borders of multinational firms, for instance, may generate ideas that are diffused throughout the firms' increasingly dispersed locations, including those in the migrants' home countries. Knowledge workers who move in order to study or do research in an academic setting are also increasingly able to plug into global networks that diffuse their ideas more widely than in the past. Even immigrant entrepreneurs find that they can share the benefits of their good fortune by building supply chain or other linkages back to their countries of origin. Global governance mechanisms may be able to strengthen these linkages between destination and source countries, alleviating the losses that might otherwise be incurred due to migration and avoiding pressure to restrict it. (Hart 2006a)

In the long run, the global talent pool should grow in response to the demand for knowledge work, equilibrating the market. Indeed, it is possible that the response in source countries could overshoot the demand in destination countries. In this case, the source countries would find themselves with larger domestic pools of talent than they would have had in the absence of high-skill migration, a "brain gain." (Stark 2002)

Two important barriers, to which global policy-makers might address themselves, may obstruct this process of adjustment. (Hart 2006b) One reflects the cumulative nature of human development. Children must be nurtured, nourished, and educated before their potential contributions to the knowledge economy can become evident. The talents of those who grow up ill or hungry or ignorant can rarely be "recovered," the way that impurity-laden oil deposits can be through the application of advanced technology, but are simply lost forever. The evolution of the knowledge economy thus adds a new dimension to the global public goods of childhood health, nutrition, and education.

A second potential barrier is the inflexibility of secondary and higher education systems in many of the source countries. These systems have sometimes become vehicles for the preservation of the social status of dominant groups or the fiefdoms of rent-seeking bureaucracies. Even effective educational systems tend to be rigid, due to the challenges of recruiting and retaining highly-skilled teachers, and of maintaining and upgrading expensive facilities and equipment. Global efforts may be able to loosen these constraints and enhance the odds of an effective supply-side response to global demand for knowledge workers.

It may well be the case that even if global governance in this domain were to advance rapidly, some countries, particularly small countries, would still suffer from a brain drain, just as some regions within the advanced countries do. (Beine, Docquier, and Rapoport 2003; Lowell, Findlay, and Stewart 2004) Some remedial action at the global level to compensate these countries for their losses or otherwise assist them may be justifiable and appropriate. This outcome, though, presents far more limited difficulties than one in which countries and companies engage in what they perceive to be a zero-sum "global war for talent" over a pool that is fixed in the long-run as well as the short-run. The war for talent scenario is more probable without a more vigorous global effort to tackle the barriers described above.

3.4 Innovation Finance

Like the markets for intellectual and human capital to support innovation, the market for innovation finance has become more globally integrated in recent years. As the data in earlier sections show, multinational R&D spending is more dispersed than in the past, and venture capitalists more frequently find deals across borders than they used to. In addition, sovereign funds in Singapore, China, India, Russia, as well as in the Gulf states are emerging as new

sources of innovation finance. These trends have the potential to allow underserved markets to benefit from improved products and services and to diversify the global pool of technology-based business ventures as well. Financing innovation is, however, a risky business. As the 2007 global debt crunch shows, systemic crises in the financial systems are recurrent and increase the risk of innovation finance. The need to manage risk limits the pace of integration, setting up a couple of important challenges that need to be addressed at the global level.

Another way of saying that integration is limited is that there is a higher level of home country bias in this area of finance than others. Indeed, the bias often goes beyond the country: "friends and family" investors are limited by social relationships; angel investors often stick to their own geographical regions; and many venture capitalists notoriously adhere to the "no connecting flights" rule. Because the payoffs of investments in innovation take a long time to materialize and the indicators of potential success are so subtle, investors prefer to keep a close personal eye on their interests so that they can provide input and exercise control at key junctures. Even multinational firms, which have a full suite of tools available for virtual oversight of far-flung technology projects, still display a headquarters bias in R&D in part for these reasons.

Projects or ventures outside the favored locale must therefore have better or more certain prospects in order to receive support. Public subsidies, such as R&D tax credits and government venture funds, provide a means to level the playing field. The appropriate level of subsidy to compensate for home country bias is, unfortunately, very difficult to determine. The public sector is also likely to have great difficulty targeting subsidies on the most worthy opportunities. Moreover, in the context of international competition, governments have incentives to overcompensate foreign investors. The result may be a leapfrogging "race to the bottom," as we

have seen in corporate taxation. Collective action at the global level has the potential to address this coordination problem, reduce waste, and inform policy-makers about how to make their efforts more effective.

A second justification for public subsidies to innovation finance returns us again to the concept of appropriability. In this case, the key idea is that the benefits of the innovative activities that the subsidies support will spill over from the firm that receives them to the surrounding communities and the nation that provide them. Benefits may flow to suppliers in the form of improved productivity, to new firms that draw on ideas stimulated by the subsidized firms, or to consumers who gain new goods and services to choose among.

As with publicly subsidized scientific research, the benefits of R&D tax credits or government venture investments are not necessarily retained domestically in a global knowledge economy. Subsidized firms, in fact, are likely to have greater control over the location of spillovers from their innovative activities than scientists who publish in the open literature. If the firm's strategy is to serve foreign markets and the subsidized activities are just one link in its global innovation network, there may be few channels by which the domestic public can benefit. In the extreme, one might see isolated, subsidized high-technology enclaves that serve to export a nation's intellectual labor, much as maquiladora factories export physical labor.

Domestic policies have vital roles to play in avoiding this sort of "internal brain drain." Governments can facilitate forward and backward local linkages from subsidized firms, and they can also foster spin-off entrepreneurship, appropriately constrained by intellectual property protection. Yet, there is a role as well for global governance, particularly (as in the case of high-skill migration) with respect to smaller countries that lack the leverage to impose conditions on

foreign investors. Global norms and rules need to be devised that would enhance the odds of domestic or intra-regional spillovers.

3.5 Global Backlash?

A final risk to the development of the global knowledge economy is the threat of backlash against globalization and perhaps against innovation as well by workers who have been displaced – or fear they will be displaced – by trade and technology. "Creative destruction" is not Pareto optimal; it imposes costs on social groups who find their earning power diminished and their skills devalued. "Is Your Job Next?," as a famous cover story on globalization of services in Business Week blared in 2003, is a question that is bound to be on the minds of knowledge workers around the world.

In the past, the welfare state helped to cushion these effects and thereby diffuse backlash against liberal trade and rapid innovation, especially in small countries with open economies. These national policies have become harder to sustain in recent decades, and the fiscal pressure on them will continue to rise in the coming ones. If this cushion against job loss disappears, workers will naturally seek to hold on to the jobs that they have even more tightly. The result could be a vicious cycle of protectionism that not only restricts trade but also the exchange of science and technology.

Global collective action might reduce the risk of this kind of backlash. While a global welfare state with the capacity to collect taxes and administer benefits is undoubtedly far in the future (if it comes to pass at all), cooperative mechanisms might be devised that would compensate those who bear the brunt of change or perhaps even moderate the pace of change so as to reduce the destruction it inflicts. We do not wish to minimize the challenges that would

have to be met in creating such mechanisms – they are severe. But the potential benefits are also great, as will become clear with the next turn of the economic cycle.

4.0 Bridging the Gap: Preliminary Thoughts

A global knowledge economy is being born as we write. Global innovation networks integrate knowledge work carried out in disparate locations. These locations now also include emerging economies like China and India. Global markets for codified knowledge, for highly-skilled professionals, and for innovation finance are expanding in scope and getting deeper. Although large corporations are driving the pace of change, smaller firms and even individual "free agents" are increasingly able to participate with some autonomy at the global level.

The growth of the global knowledge economy has the potential to bring prosperity and improve the quality of life almost everywhere. But its development is unlikely to be smooth. A series of obstacles lies ahead. Like icebergs, we can only see the tips of some; others still lie over the horizon. To help navigate through the dangers and set the most promising course, a new institutional framework must be put in place.

The exact details of such a framework are far beyond the scope of this paper. Indeed, the process of developing the framework will be at least as important as the guidance, facilities, rules, and enforcement mechanisms it contains. The global knowledge economy must be embedded in a set of norms as well as the formal apparatus of governance. Such norms will emerge in part through the very debates and negotiations that produce the formal apparatus.

In this concluding section, we set forth some preliminary thoughts about the principles that might guide the process and lay out an agenda of issues for discussion. Some of these issues may be more ripe for action in terms of alignments and coalitions than others, and that does not

disturb us. The institutional framework need not, indeed should not, emerge in a monolithic fashion. What is important is that it begin to emerge – piecemeal – sooner rather than later.

4.1. Design Principles

Our principles emphasize decentralization and flexibility in process and substance. We believe these attributes will be required on practical grounds in order to get the relevant parties to engage in productive discussions. But there is also a strong analytical rationale for both decentralization and flexibility. The global knowledge economy is a complex system with emergent properties that cannot be fully predicted. We agree with Maskus (2000: page 14) that "no specific set of optimal regulations can deal with the complexity of the national and international regulations in all circumstances." Hence, we need a decentralized, flexible process that will allow for more effective adaptation in response to changing circumstances and new learning.

Procedural Principles

- *Non-State Participation.* The process of shaping mechanisms for global governance should engage non-state actors as well as states and international organizations in substantive roles. In many cases, firms will be the only parties who can provide the knowledge and resources required for effective governance, while civil society organizations (professional associations, labor unions, advocacy groups, etc.) bring legitimacy as well as ideas and insights to the process. In areas of governance as diverse as conflict resolution and environmental protection, new formations of non-state actors are participating along with the traditional parties in devising

solutions to difficult problems. The knowledge economy governance process should build on this trend.

- *Problem-Specific Participation.* The participants in governance-making should vary according to the problem addressed. Nations, firms, and other participants have varying degrees of interest across the issue agenda. A process that attempts to link all the issues together across all the governance domains and all regions is likely to stall due to apathy, free-riding, and grandstanding. Problem-specific forums are more likely to be constructive and creative. Of course, this decentralized approach, if successful, will produce new coordination challenges that will have to be addressed over the long-term, but we would prefer to wait and see what these problems are, rather than assuming that an appropriate structure for addressing them can be devised *a priori*.

- *Balanced Participation.* The process should give equal voice to participants (both state and non-state) from emerging knowledge economies and advanced economies. Some existing mechanisms for global governance face legitimacy challenges because they are dominated by the U.S., E.U., and Japan and the firms headquartered in these locations. The growth of the global knowledge economy makes such arrangements obsolete.

The idea that it is natural and normal for new regional and national knowledge economies (like China and India) to adopt the governance formulae of the incumbent leaders, as if these were compulsory and necessary, is not obvious to the new players. The new players must be full participants in the design and implementation of global governance. However, it is equally important to secure the interests of smaller developing countries that lack the weight and

leverage of the two giants, and may not be aligned with them, need also to be fully and fairly represented (Juma and Lee, 2005).

Substantive Principles

- *Incrementalism*. Governance mechanisms should, in general, be built in small steps on the basis of existing norms and institutions. The incremental approach should allow for easier immediate progress, while also more easily accommodating course corrections, than a "big bang" effort at building something *de novo*.

The danger of replicating existing imbalances of power must, of course, be recognized and addressed before substantive progress can be made on the knowledge economy governance agenda. The new players may for now accept the rules of the incumbents, and the received norms of international relations (eg for patents or standards). But it would be a historical anomaly if, once the new players have accumulated enough power, they would not seek to influence and shape the future design of global governance approaches.

- *Competition.* Innovation, whether technological, organizational, or institutional, is an inherently uncertain process. Competition can be an important tool for learning about how uncertainties ought best be resolved, whether to satisfy customers in a market context or stake-holders in a governance process. Participants in governance must bound the competition with rules, gather information, and diffuse the best practices that result from it. Competition also limits opportunities for rent-seeking, which has plagued many international institutions.

- *Beware of Extremes.* There is a tendency for arguments about the global economy to degenerate into ideological name calling. In the prior generation of discussion about the issues we have highlighted here, the terms "techno-nationalism" and "techno-globalism" were brandished as epithets for protectionism and liberalism. We see these as false alternatives. A workable system of global governance will blend free markets with national policy activism and international collective action. Pragmatism, rather than appeal to unachievable utopias, must provide the guiding spirit.

4.2 Issue Agenda

We propose an issue agenda that flows directly from the analysis in previous sections. Although we have divided it into three baskets that correspond to the three knowledge economy assets that have been our focus, this arrangement is a matter of analytical convenience. From a practical perspective, the approach we described above suggests that the issues might be taken up singly or in combinations that need not conform to our typology.

Knowledge Capital

- Basic research: ensuring a healthy and balanced portfolio of publicly available knowledge by coordinating among national and major private and non-profit funders in order to avert the twin threats of orphan fields and hyper-competition.
- Intellectual property: limiting protectionist policies that seeks to privilege national inventors and standards over global opportunities.
- Innovation networks: providing a technological and social infrastructure that facilitates collaboration among diverse knowledge communities on a worldwide basis.

Human Capital

- Human capital development: recognizing talent on a global scale and fostering greater equality of opportunity by expanding and deepening educational systems, particularly in small developing countries.
- High-skill migration: facilitating flows of people while building knowledge-based linkages among source and receiving countries, so as to foster mutually beneficial results from migration.

Financial Capital

- Venture investment: placing entrepreneurial ventures worldwide on an equal footing to compete for funds, while controlling unwarranted subsidies and monitoring the proliferation of private equity investments.
- Investment linkages: establishing mechanisms that facilitate spillover of knowledge and capabilities from enterprises and establishments receiving foreign investment, with the goal of helping to create new knowledge hubs.

4.3 Closing Thoughts

Globally integrated enterprises are aggressively seeking advantage in knowledge-intensive industries as these industries expand in scope and deepen their penetration around the world. Digitalization and liberalization have enabled the global knowledge economy to emerge. Governments have responded to these developments by investing in national competitiveness strategies. Much less effort has gone into the creation or improvement of global governance systems. As a result, we face a dual governance gap: important areas of the global knowledge

economy remain ungoverned, while others are subject to lop-sided forms of governance that foster inequality.

If the global knowledge economy is to be sustained and its potential to be realized, the governance gap must be addressed. The solutions, in turn, will require some reduction in the asymmetries between corporate and state power in general, between the governments of advanced and emerging economies, and between large and small countries.

None of these solutions will come easily; there is no master plan nor even a process that will overcome coordination problems, supply public goods, and redress externalities. Global governance of the knowledge economy will be a patchwork. The issues are complex, overlapping, and uncertain. The players are dynamic, and their relationships are shifting. However unwieldy the process, though, its goal should be clear: to steer the emerging social capabilities for innovation in constructive directions and to build self-reinforcing momentum behind them.

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