# The Global Innovation System: A New Phase of Capitalism

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## Abstract

*This paper examines the emergence, structure, and consequences of a new phase of global capitalism, characterized by a developing Global Innovation System (GIS). While certain features of the GIS mirror pre-existing national innovation systems, it transcends these roots. It integrates national innovation complexes to the point where a coherent global structure of innovation and an associated new international division of labor have evolved, even beyond today's intricate global production chains. We describe the innovation clusters and knowledge pipelines that are increasingly knitting together this new global network. We show that key clusters in the United States still play a leading role and ask whether the new patterns of innovation can overcome the decline in advanced-country economic growth that has set in since the early 2000s.*

**Keywords:** Globalization**,** Innovation**,** Exceptionality**,** Entrepreneurship**,** Clusters**,** Growth

## *1. Introduction*

The advanced developed countries today remain mired in a protracted period of anemic economic growth. Once cyclical impediments to the restoration of full employment are overcome, it is unclear whether even the most dynamic of these countries, the United States, has the wherewithal to recapture its long-term pace of productivity advance. Robert Gordon (2012), for example, has predicted that total factor productivity growth will continue to stagnate owing to slowing technological advance. While more uncertain about the future, Tyler Cowen (2011) has brought attention to a "Great Stagnation", as the 'low hanging fruit' of the second industrial revolution has been picked clean.

There may be grounds for greater optimism. Since its origin in the early 19$^{th}$ century, modern capitalism has progressed through several major stages, most recently the globalization of production and the globalization of finance. Today one is witnessing the birth of a wholly new phase – what one might call a global innovation system (GIS). The GIS represents the fullest elaboration of capitalism's internal logic and potential to date.

This paper explores the implications of this new phase in global capitalism. In particular, it assesses whether the progressive maturation of the GIS might justify greater optimism about the prospects for a reacceleration of technological change. Owing to population ageing in the developed, and much of the developing world, economic growth will increasingly depend on maintaining a rapid pace of productivity advance based on the application of new ideas and technological breakthroughs. By massively increasing investment in knowledge and its dissemination, maturation of the GIS could stimulate faster global growth.

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Having been orchestrated in a largely top-down fashion by vertically integrated MNCs, such value chains allow companies located anywhere to specialize in distinct segments of production. In contrast, the GISresults from a more decentralized bottom-up development, characterized by a progressive breakdown or circumvention of national institutional obstacles to the cross-border sharing of ideas. More akin to a virus, it spreads via interaction, imitation, and the multi-directional movement of individuals and ideas.

## *2. Thinking Transnationally*

Traditionally, one has discussed innovation capacity using the construct of national systems of innovation. Countries have been systematically compared in terms of their relative skill sets and the effectiveness of the social institutions associated with technological advancement. Typical criteria include the quality of STEM education, public funding of basic research, the environment for start-ups, and the flexibility of labor and capital markets. Supporting these are even more fundamental characteristics such as intellectual property protection, political freedom, and the degree of competition in product and labor markets. Such comparisons of national systems underlie well-known rankings of country competitiveness such as the Global Competitiveness Index of the World Economic Forum.

From this perspective, innovation begins and ends at the border: who are the actors and what are the institutions within these national borders that can stimulate innovation? Such a framework makes sense only to the extent that the cross-border fertilization and exchange of ideas and the transnational mobility of educated people and entrepreneurs remain limited. In contrast, once national borders become porous, the utility of defining innovation in national terms and applying comparative analysis to such systems declines.

While we still live in a world of nation states, globalization is increasingly rendering national boundaries less central to economic change. Largely transcending national borders, a quasi-transnational GIS has emerged. Comprising it are regional clusters, some of which have previously been celebrated as centers of national innovation, such as Silicon Valley, but others that are less developed but incipiently dynamic and popping up all over the world. What has made it possible to talk of a distinctly new stage of global capitalism are rapidly thickening ties between such clusters, involving a more profound interpenetration and commercialization of ideas from around the world and the greater actual and virtual interaction of people conceiving and commercializing these ideas.

Innovative activity has been broadly defined as the introduction of new products, production methods, supply sources, markets, and organizations. Many distinguish between incremental (within an established process) or radical (outside of an established direction or path) innovation. To continue to develop competitive, innovative products and services in a rapidly changing, global marketplace, firms can longer rely mainly on internal knowledge and technology. Inauen and Schenker-Wiki (2011) argue that, pursuing an “open innovation model”, firms can remain competitive only by collaborating with suppliers, customers, and other knowledge sources. Firms can reduce internal research and development costs by looking for knowhow beyond their organizational limits, add Bigliardi, Ivo Dormio, and Galati (2012).

For example, a US cluster based in Silicon Valley or Seattle may have more profound interconnections with clusters in the Far East or India than with clusters on the east coast of the US. Evidence can be seen in telecommunications patents, for example: 16.2% of patents had at least two co-inventors located in two different regions during 2005-2007, double that of the late 1970s (Primi, 2013). Such seeds of the evolving GIS precede but have been vastly accelerated by the ICT revolution. As the latter develops in such directions as the expansion of online education and the further spread of data capacity on the Internet, the GIS should continue to consolidate.

Interconnections between clusters increase a firm’s ability to innovate. A study of 1604 firms in five Norwegian regions (Fitjar and Rodriguez-Pose, 2013) showed that firms that had a large and diverse set of international partners tended to innovate more than those without international partners. These international partners were suppliers and customers, as well as universities, research institutions, and competitors. Similarly, a survey of Viennese software firms (Trippi, Todtling, and Lengauer,2009) determined that those with strong ties to international competitors, research institutions, and customers saw increased radical innovative activities compared to their locally focused peers. Maskell. Bathelt, and Malmberg (2006) showed that lasting connections between localities also occur within the “temporary clusters” of international trade fairs, conferences, and conventions in which knowledge and innovative ideas are spread through participants.

A growing body of literature analyzes the effects of bi-directional or asymmetric international links on the innovation activities of specific firms. For example, experts from an international firm can willy-nilly disseminate knowhow to less-knowledgeable individuals in a different firm or cluster. Firms can otherwise intentionally pursue an "open innovation model" to increase their ability to innovate (Morrison, Rabellotti, and Zirulia, 2013). Successful clusters tend to be those with both a strong local knowledge base and robust international connections with other industry researchers and thought leaders. Such "global pipelines" enhance innovation when the cluster has a well-developed internal network for sharing and taking advantage of outside knowledge. These pipelines can be successful when experts foster connections and share information with other clusters, and then that information is diffused across the tight local network.

As nodes of the GIS, more advanced clusters of innovation are often centered on a leading research university, fast-growing corporate start-ups managed by aspiring entrepreneurs, larger, more mature albeit still dynamic corporations, a local labor pool of scientists, computer specialists and engineers, and a variety of funding sources, including deep-pocketed and risk-taking venture capitalist firms and government funding of basic scientific research. More broadly, knowledge may be shared among firms and clients, research institutions, suppliers, business partners, and competitors.

## *3. US Exceptionality*

An increasingly specialized division of labor and distinct entrepreneurial cultures characterize particular clusters of innovation. They may be specialized in particular niches such as the industrial Internet, semiconductors, biotechnology, nanotechnology, artificial intelligence or robotics. Yet, clusters can be distinguished in another important sense. Owing to differences in national or local culture and institutions, certain clusters house economic agents capable of advancing the world technological knowledge frontier. As evidenced by the flow of skilled and entrepreneurially-minded individuals and the concentration of specific types of advanced patents, the US - or more accurately specific innovation clusters located within the territory of the US - continues to occupy the central locus of this emerging transnational system. This is clear if one lists the leading global corporate innovators, a list which is dominated by former US start-ups that have achieved scale, such as Apple, Amazon, Google, Microsoft, Walmart, and FedEx. A similar list, ranking companies by R&D spending, is dominated by US-based corporations like Microsoft, Johnson& Johnson, Intel, and Cisco Systems.

Epitomizing US-based clusters is a pronounced openness, helping to attract the 'best and brightest' from around the world and contributing to the proliferation of start-ups and new product development. That Americans especially esteem the creative commercial application of ideas from wherever they first emerge helps to explain why a Steve Jobs can become a national hero. Such individuals are encouraged to exercise their creativity and to start over amidst occasional failure. Thus, the US innovation structure features what Amar Bhidé calls a concentration of 'venturesome consumers' and a persistent net inflow of students, experts, inventors, and entrepreneurs. Despite a myriad of lingering obstacles including the stingy H1-B quota system, aspiring migrants continue to flock to US-based clusters.

Thus, US 'exceptionality' has survived, indeed has spearheaded the transition to a distinctly global innovation system. Reflecting its centrality to this global system, the US educates and trains and then often "re-exports" this "human knowledge capital" back to its countries of origin. Such individuals help to spread ideas and develop new clusters of innovation elsewhere within the global system. They also tend to maintain contact with their former colleagues in US-based clusters, sharing ideas and collaborating on joint ventures.

For example, firms such as Intel have played a significant role in developing technology clusters in Israel. Historically, the US encouraged the Israel Armament Development Authority to sponsor Israeli students to attend graduate school in the US, and to build ties with US-based entrepreneurs, researchers, and investors in Silicon Valley. In turn, Google and other Silicon Valley firms built R&D clusters in Tel Aviv and Haifa. Now employees and information move easily between the two clusters, leading to innovative technology and growth in both areas (Engel and del-Palacio, 2011).

Through the development of new clusters and the thickening of ties between them, the global multiplication of ideas and new products and services intensifies. Rather than rendering the system uniform in terms of the geography of innovation, clusters increase their specialization, serving as magnets for people and ideas focused on similar concerns. This world of innovation is therefore far from "flat."

One can think in terms of a spectrum that defines the degree to which national innovation systems remain segmented versus highly integrated within the emerging GIS. In terms of major countries, the poles of this spectrum might be a more nationalist-minded China versus a highly open US, for example. China's character and pace of innovation has so far been limited by Party-instructed top-down 'command-style' research and commercialization.

In contrast, the culture that initially gave rise to the US national innovation system is the one that most naturally tends to 'jump the border,' rendering US-based actors the leaders in globalizing innovation. This is reflected for example in such indicators as the share of foreign students in US universities, the number of immigrants starting or running US businesses, the number of important patents involving cross-country collaboration, and the number of foreign companies with research labs in the US and vice versa. Such factors help to place a certain subset of US firms and innovation complexes at the structural center of the GIS.

### *4. Global Economic Growth*

Robert Gordon (2012) and Tyler Cowen (2011) have spearheaded an important debate over the future of technological change and the prospects for economic growth. Recently, Nobel economist Edmund Phelps (2013) claims that even the US has lost the cultural dynamism that made it the world technological leader. Because future technological development is impossible to forecast, the technological pessimists could be right.

Yet, two notable factors justify greater optimism. One involves the sheer multiplication of brainpower to which the global economy now has access, owing in particular to the global integration of China, India, and Russia. The second is the technology available with which to tap this expertise and the increase in interconnections linking clusters of individuals and firms globally. The integration of economies and the advent of the ICT revolution remain relatively recent phenomena. The fruits of this twin development are just beginning to be realized.

It seems reasonable to conjecture that innovation is a function of how many people are involved in the production of knowledge and the degree to which such individuals are given the opportunity to interact and learn from one another. Presumably as more and more of the capital stock embodies these ideas, and is complemented by more and more skilled labor operating within proliferating innovation clusters producing for global markets comprised of venturesome consumers, there is greater potential for productivity advance to offset, at least in part, the slowing quantitative addition of labor and capital inputs. The mushrooming of innovation clusters around the world and the thickening of ties between them provides at least a plausible basis for the future acceleration of technological change and productivity growth.

The newest parts of the GIS are often found in middle-income developing countries like China, India, Mexico, Brazil and Turkey. A strong local cluster with external connections may lead to competition and growth internally. Strong local clusters also attract outside attention from other clusters looking to draw from their knowledge base. For example, Pietrobelli, Rabellotti, and Sanfilippo (2011) describe how multinational Chinese companies have strategically invested in Italian firms in order to learn how to upgrade their own technological capacity. Even in more established clusters, international ties may be flexible and allow room for expansion and growth.

While much scope still exists for less developed countries to grow by narrowing their gap with the global technological frontier, robust and sustained global economic growth requires that frontier itself to continually advance through creative application of cutting-edge ideas. Thus, while Gordon and Cowen are focused on the US, their concerns have broader implications, since sustained global growth depends on the pace of productivity advance at the frontier. That is, since US clusters remain the central driving force of global innovation today, an ongoing slowdown of US innovation will limit global growth largely to 'catch-up growth.'

Given the extent of remaining underdevelopment, catch-up growth is hardly tapped out, owing to two continuing trends. The first is the ongoing movement of individuals from agriculture to industry and services in many parts of the world. The second is the potential for transfer of existing technology that has yet to be applied. Still, rapid and sustainable global growth will eventually require future outward movement of the global frontier. That, in turn, will require that the US reverse decades of creeping over-regulation, "rent-seeking", and lock-in of vested interests that have erected barriers to the entry of new firms and products. If that takes place, the "innovation multiplier" provided by the emerging GIS could create a new Golden Age of capitalist growth.

If this more optimistic scenario is to be realized, US technological leadership will gradually render the US less singularly central, as latent clusters of innovation are activated around the world. Such an eventuality would mirror the halving in the US share of global output within two generations of World War II, as the war-torn economies of Japan and Europe converged and developing country growth rates later accelerated.

This possibility suggests nothing about US 'decline.' It should be cause for celebration rather than despair, as the stimulation of technological change in more and more places advances global economic welfare (Brown, 2013). Nevertheless, with their first-mover advantage and cultural differentiation, US-based actors can be expected to retain a special role within the GIS for many years to come. The more so, if US start-ups and more established firms continue to heed the dictates of Schumpeterian creative destruction.

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