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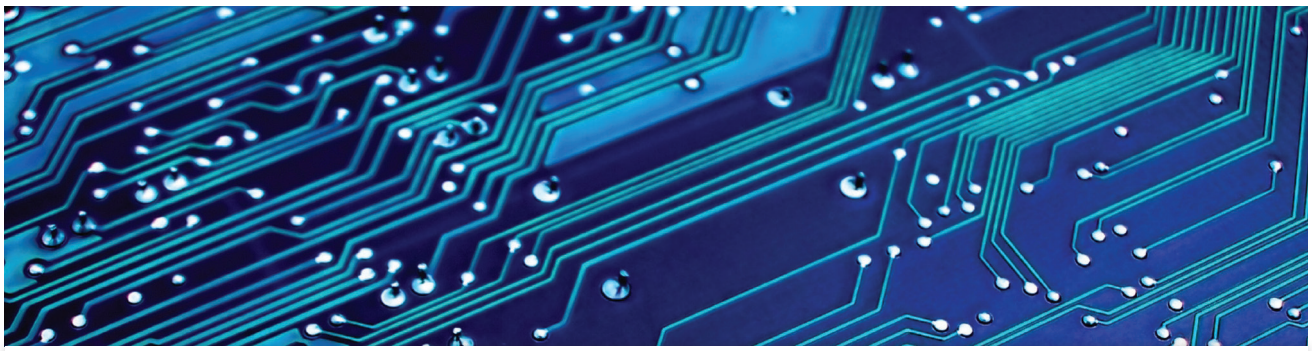

Global Innovation Networks and their Implications for the Multilateral Trading System

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ABSTRACT

This think piece examines the emergence of global innovations networks and their implications for multilateral trade rules. After pointing out, that the WTO agreements were reached with little direct attention paid to globally connected innovation and the close links among innovation, trade and investment, the think piece seeks to identify a number of options to enhance the contribution of multilateral trade rules in support of global innovation networks. Options examined include expanding GATS to encourage temporary mobility of skilled workers, considering whether procurement agreements should cover public research grants and in a longer term perspective, considering the possibility of negotiating a multilateral agreement at the WTO on access to basic science and technology (ABST).

CONTENTS

LIST OF ABBREVIATIONS

ABST	Agreement on Access to Basic Science and Technology
CBD	Convention on Biological Diversity
EC	European Commission
EPAs	Economic Partnership Agreements
ETAP	Environmental Technologies Action Plan
EU	European Union
FDI	Foreign Direct Investment
FRAND	Fair, Reasonable And Non-Discriminatory
GATS	International Economic Law
GDP	Gross Domestic Product
GINs	Global Innovation Networks
IPRs	Intellectual Property Rights
MNE	Multinational Enterprise
NGO	Non-Governmental Organization
OECD	Organisation for Economic Co-operation and Development
PCT	Patent Cooperation Treaty
R&D	Research And Development
SCM	Subsidies and Countervailing Measures
SPS	Sanitary and Phytosanitary
TBT	Technical Barriers to Trade
TISA	Trade in Services Agreement
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
US	United States
WIPO	World Intellectual Property Organization
WTO	World Trade Organization

INTRODUCTION

In the emerging, but still informal, literature, global innovation networks (GINs) are defined in either narrow or broad terms.[1] In the narrow sense, the term refers to the establishment within a multinational enterprise (MNE) of one or more research and development (R&D) affiliate facilities at different locations around the world, along with the consequent R&D management, specialization decisions, and exchange of information among them and the parent company. This concept, along with explaining the determinants of R&D location choice and the anticipated efficiency gains, lies at the core of the business-economics literature on the globalization of innovation, some of it long-standing (Cantwell 1995; Santos et al. 2004; OECD 2008). These networks are the outcome of purposeful and strategic decisions, and their recent growth has largely paralleled that of vertical production networks.

The broad concept recognizes that innovation networks incorporate many actors, including MNEs (which may collaborate in R&D), high-tech startups, universities and public research laboratories, venture capitalists, specialized technology brokers, standard-setting organizations, and government agencies. These networks emerge more organically as various entities recognize the potential gains from specialization (for example, basic research versus commercialization) and collaboration (for example, in licensing, public-private partnerships, and cross-border research alliances). These broader networks have a mix of objectives, ranging from basic revenue generation through efficient knowledge creation and use to the solution of global public problems requiring complex research investments (Maskus 2012).Both private firms and government policymakers increasingly see attachments to GINs as critical sources of competitiveness, growth, and technology transfer.

The question we pose here is whether the rules of the multilateral trading system (essentially the World Trade Organization, or WTO) are adequate to the task of encouraging such growth and collaboration where it is beneficial. It is a timely subject for a number of reasons. For example, the United Nations (UN) is beginning its assessment of what the next round of Millennium Development Goals (MDGs) should be, as the existing structure comes to an end in 2015. One critical element under consideration is increasing access to knowledge and information for people in poor nations. For another, the World Health Organization (WHO) is discussing the idea of a global R&D treaty for public health that would rely on various GINs in that industry. Whether the ideas and structures these groups may develop are fully consistent with WTO restrictions, and what to do about the latter are questions worth exploring. Yet another is the new tendency, at least within European Union (EU) negotiated Economic Partnership Agreements (EPAs) with developing countries, to include language about facilitating the access of local researchers to public research subsidies in Europe. Meanwhile, many countries are in the process of developing policies governing technology transfer from publicly supported research labs to private enterprises.

Finally, the grace period for achieving compliance with Trade-Related Aspects of Intellectual Property Rights (TRIPS) stipulations has ended for all developing countries except those that fall under the category of "least developed" (who recently received an extension until 2021 for achieving TRIPS compliance). Thus, it is important for those countries (such as Brazil, China, and India),which had sufficiently developed their local R&D networks based on imitation and reverse-engineering during the pre-TRIPS era, to find ways to better integrate their local capabilities with global networks, perhaps to the mutual benefit of all concerned. Equally, other developing economies face significant challenges in finding a sustainable means of linking their more limited research and innovation capacities to the emerging world of global innovation. It would be useful to know whether such transformation in the nature of local R&D efforts and their integration with GINs calls for some modifications to the rules underlying the multilateral trading system.

Among longer-term issues are whether WTO rules on subsidies (for example, state aid and support for applied research), procurement, intellectual property rights (IPRs), and movement of labor are appropriate for facilitating GINs. Another is whether R&D collaboration and standard setting may raise issues for competition policy that could, perhaps, be addressed in a multilateral setting. A still broader issue is the potential for developing a multilateral agreement at the WTO on access to basic science and technology (ABST), an idea first described in Barton and Maskus (2006).

It is fair to say that WTO agreements were reached with little direct attention paid to globally connected innovation, and the close links among innovation, trade, and investment. To some degree, this makes sense—greater innovation can be the outcome of trade liberalization and adherence to border disciplines. However, it is more accurate to state that innovation is a fundamental source of comparative advantage, and that investment and trade in goods and services is an important means of facilitating exchanges of technology. Indeed, the latter increasingly happens in direct technology markets, including within and among research networks. A revisit therefore seems in order.

In this context, the challenge for this paper is threefold. The first is to identify those elements of WTO rules that may fairly be thought to impede the full connectivity of innovation networks, especially in terms of participation by developing countries. The second is to focus on a small subset of elements that may offer fruitful prospects for discussion at the next

1 | We first encountered the interesting acronym GINs in Ernst (2006).

ministerial meeting. Here we focus on two ideas that have at least one foot in feasibility—expanding the General Agreement on Trade in Services (GATS) to increase the temporary (though longer-lasting) circulation of technically skilled workers, and considering whether procurement agreements should cover public research grants. The third is to build on these ideas as a foundation for ultimately negotiating an ABST.

STATEMENT OF OPPORTUNITY

Available measures of the scope of GINs are scarce and fragmentary, so it is difficult to make a direct case for their importance. However, there clearly has been a substantial recent rise in the pace at which MNEs invest in research facilities in different countries (OECD 2008). Most of these investments occur among the developed economies, with the United States (US) the largest inward recipient. However, China and India recently have taken spots among the top 10 gross recipients of research facilities within enterprises and among research collaborations. These research affiliates and contract R&D facilities (often recipients of investments from multiple MNEs) exist for numerous reasons—the traditional objective of modifying products for local markets; plus newer ones of locating R&D close to growing markets; taking advantage of lower-cost research personnel for intermediate steps in the vertical R&D chain that can be outsourced; and establishing centers of original innovation. For their part, Chinese and Indian enterprises also increasingly invest in R&D facilities abroad, most prominently in the US and Europe, to gain access to improved technologies.

Another measure of research collaboration is the rapidly growing numbers of patent applications involving inventors from one country and applicants from another, typically the headquarters (OECD 2008). These applications, featuring collaborations between many pairs (and more) of countries, are growing dramatically at the United States Patent and Trademark Office (USPTO), European Patent Office (EPO), Japan Patent Office (JPO), and other major patent offices, plus the Patent Cooperation Treaty (PCT) at the World Intellectual Property Organization (WIPO). Yet a third is the remarkable recent growth of joint publications in scientific and technical journals, featuring authors from private and public laboratories, research universities, and foundations in multiple nations. Moreover, some recent research using such indirect data points out the importance of face-to-face meetings in expanding research productivity within affiliated networks and creating spillovers across units (Montobbio and Sterzi 2011; Hovannisyan and Keller 2013).

These metrics are informative and useful for analysis, though they do not directly measure the growth of innovation networks and, for the most part, fail to offer sectoral or firm-level information. It is likely, for example, that GINs facilitate cooperative research and knowledge sharing among small and medium-sized enterprises (SMEs), serving as a leveraged and potentially powerful tool for innovation. More fundamentally, there seem to be few databases to consult on the emergence of important inter-enterprise and cross-border research collaborations, and virtually nothing on complex arrangements involving universities, private firms, and foundations. It would be useful, then, for data-gathering organizations to consider how to improve our statistics and even taxonomies of GINs.

Measurement aside, the significant growth and complexity of innovation networks raises some challenges for national policymakers. Many could be discussed, but we mention four here. First, authorities in advanced countries that traditionally dominate R&D spending and innovation have two concerns—encouraging GINs to invest in R&D (or even scientific) facilities in their own countries, and preventing their own companies' outward investments in R&D abroad from reducing employment of skilled and semi-skilled domestic workers. Both these concerns arise from a mix of technological mercantilism and the belief that the dynamic benefits of innovation can be largely localized. The evidence on the scope of knowledge spillovers generated by innovation (that is, whether they are domestic or international) is difficult to interpret since it requires one to adopt a temporal perspective in addition to a geographic one that has frequently been adopted by researchers (Saggi 2002). After all, the fruits of R&D conducted in one country are bound to eventually become available in other countries provided sufficient local absorptive capacity exists. The real question is how long this process takes, and whether and how it differs across industries. Too strong a faith in localized spillovers is likely to push policymakers toward a more aggressive use of nationalistic subsidization and tax advantages for high-technology firms, including those from abroad. As for employment concerns, their validity depends primarily on whether the formation and location of GIN-linked facilities abroad are substitutes or complements for domestic R&D spending and jobs. In principle, investments in global research facilities can either displace research workers in parent locations (substitutes) or generate sufficient economies of scope to expand local research activities (complements). This question seems to be unanswered in the economics literature.

Second, authorities in developing countries have a related concern—if the nexus of innovation is increasingly going to come from collaborations, networks, and alliances, how can they position their own enterprises (or even universities and technical workers) to participate in a way that generates both inward technology flows and the possibility of domestic innovation and growth? Put differently, policymakers may need to revisit the question of whether domestic interventions (for example, industrial tariffs, foreign direct investment [FDI] regulations, and limitations on intellectual property) that are designed to force technology transfer work very well in a world of GINs. Indeed, similar concerns exist on the general use of

industrial policy since it is not clear whether in today's world economy, increasingly dominated by global production chains, it makes any sense to even try to encourage the establishment of local industries in particular areas. Widespread outsourcing and vertical production links across borders have led to the development of some recent economic models that focus on trade in "tasks" as opposed to "goods" (Grossman and Rossi-Hansberg 2008).

The other two issues are more cross-border in nature. First, we remain in a multilateral environment where trade policies and regulatory rules are the province of national authorities. With GINs, however, national policies have cross-border reach in that the benefits of subsidization or investments in technical capacity may partially move abroad. That there are policy spillovers is true of any trade and investment policy, but two differences arise here. One is that knowledge cannot easily be appropriated in one location, always a devilish fact for public research investments. The other is that GINs may considerably enhance this outward leakage of the gains from such investments, though we do not have formal empirical evidence on this.

Finally, there is the whole question of facilitating information and technology flows across innovation networks that go beyond private or corporate entities to participation by universities, charitable foundations (even non-governmental organizations, or NGOs), private enterprises, and public agencies. Such arrangements may be focused on private commercial gain, as in the case of the vertical organization of pharmaceutical and microelectronics product development, combining basic (and heavily subsidized) science with clinical trials, standards development, and endpoint product delivery. Others may be focused on the development of solutions for quasi-public goods, whether in medicines, agricultural inputs, environmental technologies, or educational products.

At this point we have succeeded only in setting out the broad framework of a research agenda for economists and legal scholars. But hidden within these challenges are substantive questions for multilateral trade rules.

RESPONSES

What are the primary WTO rules that may impede the formation and growth of GINs? We found no systematic evidence aimed at this specific question and undertaking such a study could be particularly valuable. In its absence, we are not confident about the relative priorities of the items below. However, there are anecdotal claims that specific problems can be fruitfully addressed in a way that reduces roadblocks to global networks.

MEDIUM-TERM RESPONSES

Contemplate research regulations as possible technical barriers to trade

The WTO Agreement on Technical Barriers to Trade (TBT) is aimed at disciplining protectionist regulations on product characteristics, including elements of production processes. However, it does not address service and research regulations that could inefficiently restrict trade and, by extension, international investments in research networks. Yet there seems to be no apparent reason why its basic philosophy could not be applied to disparate R&D processes so long as those differences result in suitably safe products. The following are some examples.

- Protocols governing clinical trials and testing for medicines, biotechnological inventions, and plant varieties can be quite different, even among high-income economies such as the US, EU, and Japan (Maskus and He 2011). These differences can lead to delays and prohibitions in the acceptance in one country of products developed and approved in others, while raising the costs of investing in research to meet multiple approval protocols. The traditional view that the results of successful innovation can be exploited globally ignores that such differences in local regulations, particularly in the area of pharmaceutical innovation, can hamper this process.
- Similarly, governments may ban the testing of new bioengineered crops developed abroad within their borders, even if there is little indication of potential damage. Yet clinical trials and new product testing are obvious candidates for deploying in different locations around the globe, which can both reduce the costs of research, and target the anticipated outcomes to local or regional markets.
- At the level of final marketing approval of new products, including medicines, plant varieties, electronics, building materials, and many others, an increased reliance on mutual recognition of standards across borders is pro-trade and pro-FDI (Chen and Mattoo 2008). The need to comply with multiple varying standards across countries in the development of new products likely diminishes the potential for building integrated international innovation networks.

In this context, the proposal is to consider revisiting the TBT and perhaps Sanitary and Phytosanitary (SPS) Agreements with a view to understanding whether regulatory restrictions on research actually amount to disguised barriers on trade in innovation.

In proposing such consideration, we recognize the sensitive issues faced by regulatory authorities that could raise resistance to movements toward standards harmonization or mutual recognition. Pharmaceuticals in particular may

be problematic. Health authorities in developing countries may worry that a harmonization process would imply largely accepting the decisions of stronger authorities in industrialized markets. While this outcome may be efficient in principle, it faces the risk that health regulations in the latter countries may be "captured" by commercial pharmaceutical interests, leading to loss of regulatory control by the former nations. While it is possible to envisage partial solutions to this problem, such as choosing among regulatory decisions reached in a selection of industrialized and emerging countries, that outcome would also be difficult to reach and may be unwieldy in practice. Thus, pending further study, we imagine that sectoral carve-outs may be necessary if there is to be application of TBT disciplines to regulations of research services.

Using GATS to liberalize research services

As noted, the TBT approach, in which compliance regulations may raise duplication costs and inefficiencies, may encounter significant resistance if those regulations are subject either to TBT disciplines or harmonization. A meaningful alternative worth pursuing would be to bring research services into GATS negotiations for those countries willing to liberalize the sector in particular ways. R&D services, ranging from equipment purchases and testing protocols to grant management and accounting and beyond, are often heavily regulated in favor of domestic providers. Commitments to open such services to competition, whether through GATS or perhaps the emerging Trade in Services Agreement (TISA) could offer efficiency gains and improve the network linkages considered here.

Expanding GATS to encourage temporary mobility of skilled workers

Much is made in the innovation management literature of maximizing "brain circulation," in part to avoid the perceived pitfalls of permanent "brain drain" depriving developing countries of talent. The evidence suggests that a significant form of international technology transfer is the temporary (although not brief) relocation of technically trained and entrepreneurially skilled personnel from countries where production technologies are inside the frontier and R&D is lagging to where those skills might be fully utilized. The reverse flows can contribute to technology transfer as well. Moreover, the development of GINs is likely to be facilitated by the relatively unimpeded flow of such personnel among R&D and production facilities for temporary stays. Similar comments would apply to research professionals, faculty, and graduate students moving between universities and public research labs, and also migrating to spend time in private R&D affiliates.

To some degree, the developed economies are moving in this direction with, for example, expanded H1B visas in the US and relaxed standards in Europe, Canada, and Australia for finishing doctoral students to remain and gain early residency. However, significant restraints remain in place and it can be costly and difficult to achieve the needed work visas. Surely a more efficient system would link skilled workers together in an "innovation zone" in which countries would agree to permit longer-term (for example, 10-year) work visas that could be valid in all the participant countries. The concept would be to facilitate free circulation of technical and entrepreneurial talent among the member nations, permitting them to be deployed freely in the associated innovation networks.

Thus, the proposal is to work toward a plurilateral agreement, presumably under the auspices of GATS, for significantly liberalized skilled labor flows under the guise of an "innovation zone" work visa. The agreement would need to pay attention to how the certification of skills acquired in different professions and in different countries is to be recognized by the members, though a strong tilt toward mutual recognition seems appropriate. Since the vehicle would be GATS, presumably countries could reserve certain sensitive professions or perhaps enact safeguards, for example, to ensure that security-sensitive positions in public agencies or research labs are ineligible.

Clarify the extent of subsidies or procurement disciplines on research grants

To date, publicly funded research grants to scientific laboratories at universities have been considered outside the bounds of the Agreement on Subsidies and Countervailing Measures (SCM) because they are pre-competitive and (arguably) not specific to an enterprise or industry. It is difficult to imagine this basic understanding changing.

At the same time, we wonder about how far a complaint under the SCM might get in the era of GINs. Biomedical research grants, for example, generate knowledge that, for a paid license, ends up in the hands of private enterprises that develop products for trade. This is true also of agriculture, electronics, and a raft of cutting-edge technologies such as biosynthetics and nanotechnologies. We can expect it to enter other sectors as well as the scope of "Pasteur's Quadrant" grows in the future.

Recent legal decisions in the US question whether universities should not be considered commercial enterprises in their research function.[2] Imagine a situation, then, in which a university research laboratory, paid for via public research grants, is used extensively to undertake research contracted to private firms, which will license or explicitly own the productive output of that research. Would that situation really describe a "nonspecific" or "pre-competitive" subsidy from the government? Is the subsidy to the university or the beneficiary enterprises? And what would the reaction be if, say, a Japanese engineering firm developed a standard-essential patent for a new generation of wireless communication using a research contract with a US professor whose lab had been publicly funded?

2 | Madey v. Duke University, 307 F. 3d 1351 (CAFC 2002).

Again, we recognize the highly sensitive issue of attempting to define how research grants may act as subsidies, as defined under the SCM. Countries should have flexibility to deploy policies encouraging research that attempts to solve even applied technical questions but does not aim at a commercial export advantage. Indeed, the SCM rules explicitly are about subsidized trade in goods, and demonstrating the indirect linkage between a basic research grant and a specific export opportunity would be difficult. In this context, caution is warranted in linking research subsidies to the SCM until further study.

A related element, however, is that public research grants often are tied to nationalistic ownership options. For example, US innovation policy encourages patenting of technologies developed with public support, and the rules favor commercialization approaches that discriminate in favor of domestic firms (Barton 2007). The Environmental Technologies Action Plan (ETAP) of the European Commission (EC) provides fiscal support to firms bringing green technologies to market. Many other developed and emerging economies offer similar commercialization subsidies.

All of which is to say that the WTO approach may be somewhat dated in its principles and definitions. We argue that perhaps the appropriate solution here would be for public grants agencies to be open to proposals from international research teams, though again this might call for a more plurilateral approach. In this context, the grants could not be considered protectionist spurs to research on the input side. Complementing this would be a proscription against favoritism in licensing or technology ownership. The latter element may fit better under a codicil to the Procurement Agreement.

A LONG-TERM OBJECTIVE

Two of the foregoing ideas—liberalization of skilled-labor migration and open competition for research grants—form components of a broader and far-reaching concept, the ABST. Maskus (2012:Chap.5) offers a detailed exposition of what such an agreement could entail. We summarise the idea here and offer it as a possible element for future substantive directions in WTO.

The fundamental notion of an ABST, meant to complement the global IPRs system, is to preserve and enhance the global commons in science and technology without unduly restricting private rights in commercial technologies. The mechanism would be to place into access pools the patented results of publicly funded research that develops knowledge capable of supporting applied science and R&D, especially in areas of common global concern, such as climate change and medicines. In essence, funding agencies in the participating nations would certify that, as a condition for receiving a grant in specific areas of primary science, universities and scientists must agree to place the resulting patents in common resource pools. These patents would then be available for license to all competent agents from other member countries under terms worked out in advance.

One basic model would be to license on "fair, reasonable and non-discriminatory" (FRAND) terms, following the lead of standard-setting organizations. In the ABST, however, there should be scope for offering concessional terms to researchers from poor countries, so long as there is no discrimination among applicants within graduated country bands. Moreover, the agreement could encourage researchers from member countries to participate in, or compete with, local research teams for grants and subsidies, combined with increased opportunities for temporary migration. It would also give researchers in other countries access to scientific knowledge and data produced from publicly funded research.

One might argue that an ABST would best be negotiated within WIPO, United Nations Educational, Scientific and Cultural Organization (UNESCO), the World Bank, or even a new multilateral entity focused on the governance of knowledge. However, in our view, it should reside at WTO for several reasons. First, without a multilateral agreement to discipline free riding, any plurilateral agreement may not be sustainable. Second, the WTO already manages agreements governing intellectual property, subsidies, standards, and trade in services, all of which would be interrelated strongly with the transfer of scientific results. Third, the WTO offers an established format for settling disputes arising between governments. Fourth, WTO negotiations permit tradeoffs across sectors and functional agreements. Finally, many of the essential WTO principles can be applied to an ABST.

Several difficult issues would need to be addressed in the treaty. First would be its scope in terms of subject matter and processes. It is not easy to determine the dividing line between basic and applied research. One definition of basic knowledge is that which is truly non-rival, has limited commercial utility, if any, and is an intellectual input into other science. Another class of basic technologies would be those supporting the provision of global public goods, such as environmentally sound inputs and essential medicines. It is evident that reaching an agreement on this scope would be controversial.

There is no indisputable and practical sense in which these characteristics might be universally defined. One way to manage the distinction would be to include, as elements of the treaty, research processes and results and data that are both fundamental knowledge inputs and largely publicly funded, whether through direct research in government laboratories or grants to universities, NGOs, or other institutions. This makes sense since most basic and public goods technologies require public financing. Thus, focusing primarily on publicly funded research and data may be sufficient for most purposes, subject to the safeguards mentioned below.

A second question would be the forms in which access is to be granted, or the nature of liberalization. In principle, three levels of commitment could be entertained. First, "input liberalization" would permit researchers from other countries to participate in, or compete with, local research teams for grants and subsidies. This could be combined with increased opportunities for temporary migration of scientific personnel. However, governments could choose to reserve their research results for preferential use by local firms and the registration of IPRs. This approach would expand research efficiency and transfer more skills abroad, but its scope for raising global access to knowledge would be limited.

Next, "output liberalization" would simply offer researchers in other countries access to nationally generated science and data. This approach would usefully expand the public commons and increase knowledge diffusion, but would not directly expand efficiency or transfer research skills. A key provision would promote access to scientific databases and ensure that intellectual property regulations do not limit access to basic scientific knowledge deposited in commons pools. The US, for example, could meet terms of an ABST by modifying the Bayh-Dole Act to require non-exclusive licensing of publicly funded basic research results.

Finally, "full liberalization" would combine these approaches, both expanding international flows of research contracts and personnel, and increasing global access to outcomes. As an economic matter, we favor full liberalization to the extent it is politically feasible. In getting there, however, it may be necessary to adopt something like a GATS approach, permitting governments to reserve sensitive areas of technology and to designate different levels of commitment to open access.
A treaty of this kind would need to be balanced by safeguard clauses. One issue involved in international collaboration is the equitable and efficient distribution and management of intellectual property that could emerge from subsequent applied innovation. To what extent would originator universities depositing basic research results be able to benefit from downstream applications? Another is that concerns about national security and technology proliferation would need to be addressed.

It would also be possible to build in preferential advantages for poor economies. For example, where data and research results are to be made available in licensing pools at some cost, differential pricing schemes for governments and institutions in poor countries could be encouraged. Efforts to encourage research participation by scientists and engineers from developing countries could be written into proposal solicitations.

Two other issues would need to be addressed. First, the provisions of an ABST may need to be reconciled with other WTO agreements, primarily TRIPS, and such non-WTO accords as the Convention on Biological Diversity (CBD). Similarly, an ABST could shed light on the meaning of pre-competitive research subsidies and how they might be provided internationally. No doubt a close reading of these WTO rules and agreements would raise thorny technical issues regarding the consistency of an ABST and we encourage investigation into such concerns. Second, there would need to be provisions for regular meetings and a small council to evaluate the extent of scientific and technological cooperation and its benefits.

CONCLUSIONS AND RECOMMENDATIONS

GINs are here to stay and are likely to grow in importance as the need for scientific research, technology development, and knowledge diffusion takes greater hold, both for building competitiveness and addressing information-oriented public goods. In most dimensions, WTO rules and agreements were established before the emergence of GINs, making them ripe for reconsideration.

We set out four medium-term areas of policy change that might fruitfully be solidified and advanced over the next couple of years. One is to consider the extent to which technical regulations on R&D services may impede efficient specialization of knowledge work around the world within GINs. These issues arise primarily in areas where national administrative control of R&D and production processes seems important for sustaining consumer health and safety, such as development of medicines, foodstuffs, and biotechnology. However, these protocols often require duplication of effort and costly compliance investments that could be reduced with liberalization commitments, including mutual recognition. The real question is whether service regulations in the R&D area really amount to costly barriers to innovation, both by itself and within networks. In this context, a second (and alternative) idea is to subject R&D services, as a sector, to potential liberalization commitments in the GATS or within an emerging TISA.

A third idea, and the one with greatest promise both in terms of political feasibility and real gains in knowledge diffusion and GINs formation, is to work through GATS to establish a plurilateral (but preferably broad and inclusive) innovation zone within which skilled researchers and technical personnel would be able to migrate freely for lengthy periods of time. Such visas would directly address the needs of both private and public-private GINs for circulating brains among their various facilities. It also has considerable potential for expanding technology transfer, both among developed economies and from them to

developing countries, as skilled workers operate in various locations and ultimately bring their knowledge and training back to their original locations. Again, presumably the most efficient approach to accepting professional certifications would be mutual recognition. In any case, sponsorship of such visas by members of GINs would be a signal that the relevant skills and talents exist.

The final medium-term idea is to clarify, with further study, the relationships between public research grants and permissible subsidies under the SCM. This issue has not come up before in WTO and the membership may automatically see such grants as permissible because they are pre-competitive and non-specific. However, these characteristics may come under increasing scrutiny as research grants effectively underwrite private R&D going forward, while the outcomes of the research may be subject to discriminatory commercialization regulations. As for policy, we argue for opening such grants to global (or plurilateral) competition, with complementary safeguards against favoritism in licensing or technology ownership.

Our analysis concluded with a description of a longer-term policy, an ABST, to address problems of diffusion of basic science and technology. This policy would have benefits beyond the facilitation of GINs and help manage or resolve important public goods problems. Such a treaty could focus on liberalizing inputs (grants and scientific personnel), outputs (knowledge, databases and publications), or both, with an emphasis on placing basic scientific results into common pools available for licensing.

However, an ABST would be asymmetric, in that basic science today is performed overwhelmingly in a small number of technologically advanced countries, which likely would see its provisions as unattractive in mercantilist terms. Thus, successfully negotiating an ABST anytime soon would seem unlikely, unless offsetting concessions could be found through negotiations. We believe that this conclusion may be somewhat pessimistic, however. As Maskus (2012) argues, there are factors that could make the distribution of benefits more equitable. Importantly, MNEs themselves have an interest in disseminating technical information widely within their innovation and production networks, making them potential allies of a well-structured ABST proposal. Further, opening basic science to participation by researchers around the world could do much to help globalize the R&D needed to address areas of internationally shared concerns, such as climate change mitigation, energy conservation, and development of essential medicines for patients in poor nations.

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