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This week's readings touch on research programs, national innovation systems, research collaborations within and between countries, and collaborations among academia, industry, and government.

Wagner provides a comprehensive approach to science for development in her book, describing the model of scientific discovery that is increasingly open in new ways to developing countries because of information and communication technologies, travel, immigration (both to developed countries and by expats returning home), and the scientific ethos with loyalties not to nations but to communities of knowledge discovery. But, while the global science network is increasingly open, "it is not equally accessible to all" (p. 62). Therefore, Wagner describes ways for scientists in developing countries to engage with the global community, where "the real challenge is how to get a country's researchers into the new invisible college and then attract other researchers to work on local problems" (p. 67).

Local problems and local knowledge are themes within Agrawal's paper, in which he takes issue with those who seem to simultaneously elevate indigenous knowledge as something afforded special value while marginalizing it to a novelty class distinct from "western knowledge." While intending to liberate local knowledge, Agrawal sees the "neo-indigenistas" as simply furthering the power imbalance in current knowledge systems. Agrawal wants to move, it appears, to a more postmodern approach where there are no clear-cut dichotomies between western and indigenous knowledge. Progress can be better made, per Agrawal, when people acknowledge that the value in knowledge can vary and bridges of engagement are established across different communities and contexts.

Establishing those bridges and ties does not come without its own issues. Wagner observes a tension within the global science network around how to organize its efforts. That is, "establishing the right balance between the goals of equity (which favors distribution) and those of knowledge creation (which in many cases favor concentration)" (p. 78). Spielman addresses the same issue in a discussion of the "aggregation of knowledge production," which "refers to the way in which the contributions of individual countries and actors determine the total quantity of knowledge produced, or how scarce resources for research are most effectively distributed among countries" (p. 195). Spielman believes that the "best shot" approach, similar to Wagner's "concentration" will not result in optimal pro-poor policies. A "weak link" approach, per Spielman, focusing on relevancy at the local level (versus global impact) can engage smallholders most effectively.

For Wagner, the solution may be in building networks that facilitate that balance, driven by such "forces and structures" as "preferential attachment and cumulative advantage, trust and social capital creation, and the incentive system that leads scientists to share data and exchange information" (p. 105). Spielman's concerns about agriculture research would likely lead him to not be as optimistic about the success of such networks. According to Spielman, because of intellectual property constraints, the agbiotech era "does not facilitate the free exchange of knowledge" (p. 198). Patent thickets for genetically modified crops are, for examples, barriers to Wagner's hope for science as a global public good.

Even if knowledge is freely available and accessible to scientists in developing countries, there are still barriers according to Wagner---"the problem lies in the inability of certain places to

integrate knowledge and direct it toward solving problems” (p. 79). This is seen in the case studies, for example, as in Thailand where increasing the “supply of trained personnel” (college graduates) has not “addressed the range of technology absorption and diffusion needs of both Thai and more technologically advanced foreign firms” (Brimble & Doner, p. 1022).

To efficiently and effectively engage in global knowledge communities and apply knowledge to local problems, Wagner advocates against lesser developed countries replicating the research models of the developed worlds (e.g., the NIHs and NSFs). Rather, she points toward a future solution that will rely on “local investments and link to existing resources” through a restructured “virtual geography of knowledge” (p. 80). As an example of local investment and linking, Wagner cites Vietnamese shrimp farming where “policies had to be designed to capture ... embedded knowledge, make it accessible to research, feed the results back to those working in the field, and obtain their feedback once again” (p. 91).

Wagner provides some interesting examples, such as Vietnam and Uganda, where scientific communities have benefited from enlightened policy makers. She goes further to recommend that governments fund science research through “non-political citizen councils, which would coordinate with existing scientific academics and agencies to design visions for the role of science at the local, regional, and global levels” (p. 108). This citizen-centric coordinating role brings to mind the period from the early 1940s through the establishment of the NSF in 1950, where there was a vigorous debate around post-war science policy in the U.S.

Vannevar Bush was the key player, with his views represented in his report delivered to President Truman titled “Science: The Endless Frontier.”<sup>1</sup> Issued in 1945, three months after President Roosevelt’s death, the report was written in response to FDR’s request of November 1944 asking for a post-war strategy to deal with national health, national security, national well-being (i.e., economic development and jobs), and maintaining world leadership. Bush’s policy adversary was Senator Harley Kilgore of West Virginia. Beginning in 1942, Kilgore had pushed for an Office of Technological Mobilization (later the Office of Scientific and Technological Mobilization) that would organize all U.S. federal research, both civilian and military.<sup>2</sup> Among Kilgore’s aims were enhancing economic opportunities, thus he saw leadership for the agency appointed by and responsible to the president and drawing from small businesses and organized labor, among other groups. Bush also initially proposed a super agency, the National Research Foundation, which would address both the natural sciences and strategic military research. Bush, however, advocated for an agency that scientists would lead, with the priority being basic, as opposed to applied, science with minimal political interference. Accountability would be to the scientific leadership and not the president. After years of hearings and abortive legislative attempts, a compromise was reached. The result was the National Science Foundation, with the military still controlling its own research.

One can speculate that Bush may have been concerned about Kilgore’s proposed political appointment process for citizen oversight of U.S. research priorities. This is not to say that various stakeholder views shouldn’t be addressed. But, the negative experience in Thailand provides a view into what happens when “business interests control policy directly” (Brimble & Doner, p. 1034) if politicians end up subservient to industry. Particularly, as in the Thai case, if those from industry have “historically shown little interest in innovation and R&D” (p. 1021).

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<sup>1</sup> Vannevar Bush, “Science: The Endless Frontier,” U.S. Government Printing Office, 1945. Retrieved from <<http://www.nsf.gov/od/lpa/nsf50/vbush1945.htm>>.

<sup>2</sup> Kevles, D., “The National Science Foundation and the Debate over Postwar Research Policy, 1942-1945: A Political Interpretation of Science-The Endless Frontier,” *Isis*, Vol. 68, No. 1, March 1977, 5-26.

As a Democrat and populist, Kilgore also had concerns about big industry domination of scientific R&D, even if he and Bush disagreed on the oversight mechanisms for U.S efforts. In a letter to *Science* in 1943, Kilgore attacked big oil industry concerns about government investment in science research, even accusing the Universal Oil executives of using Hitler's rhetorical techniques in constructing the argument against the bill! Kilgore felt it was important that the government provide "widespread support to basic research":

This would apply particularly to universities and colleges, where fundamental research should flourish. Insufficient funds have caused our educational institutions to depend increasingly on industrial grants and fellowships. This, to an alarming degree, has reduced much of university research to the status of handmaiden for corporate or industrial research, and has resulted in corporate control of many of our schools.<sup>3</sup>

The risk in Kilgore's model of federal research funding is that while his intent was to use small business owners and labor leaders to counter-balance the interests of big business, future administrations may not have shared his views on balance and the result could have been more like the current situation in Thailand. Bush's model, on the other hand, established a sustainable approach to a mostly, though not completely, politically independent agency, the NSF, that this year celebrates its 60<sup>th</sup> anniversary.

**Week 5: RESEARCH, KNOWLEDGE, AND COLLABORATION (Feb 15<sup>th</sup>)**

Caroline Wagner, *The New Invisible College: Science for Development* (Brookings Institution Press, 2008), pp 51-120.

D. Spielman, "Pro-poor Agricultural Biotechnology: Can the International Research System Deliver the Goods?" *Food Policy* 32:2 (2007), pp 189-204.

M.F. Mrazek and E. Mossialos, "Stimulating Pharmaceutical Research and Development for Neglected Diseases," *Health Policy* 66:1 (2003), pp 75-88.

Arun Agrawal, "Dismantling the Divide between Indigenous and Western Knowledge," *Development and Change* 26:3 (1995), 413-439.

Swiss Academy of Sciences, *Cooperating for Success: Benefits of Research Partnerships With Developing Countries* (November 2009).

P. Brimble and R. Doner, "University-Industry Linkages and Economic Development: The Case of Thailand," *World Development* 35:6 (2007), pp 1021-1036.

K. Chen and M. Kenney, "Universities/Research Institutes and Regional Innovation Systems: The Cases of Beijing and Shenzhen," *World Development* 35:6 (2007), pp 1056-1074.

D. McCormick, "African Enterprise Clusters and Industrialization: Theory and Reality," *World Development* 27:9 (1999), pp 1531-1551.

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<sup>3</sup> Harley M. Kilgore, "The Science Mobilization Bill," *Science*, Aug. 13, 1943, 98:152.