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Improving Technology Commercialization to Drive Future Economic Growth

Chairman Lipinski and Members of the Subcommittee:

Thank you for this opportunity to testify before the Subcommittee focused on the role that improving technology commercialization of government-funded research can play in driving economic growth and job creation. If there is a silver lining to the economic crisis our country now faces, it is that policymakers and academics, as well as citizens, are now paying tremendous attention to job creation and economic growth. For far too long, the sources of job creation have been taken for granted. The Ewing Marion Kauffman Foundation has been interested in economic growth through the mechanisms of innovation and firm formation, and we welcome the renewed focus on these issues generally, as well as the more narrowly focused conversation we will have today on technology commercialization.

In my testimony today, I will highlight three main policy proposals and review the Kauffman Foundation's current thinking on best practices in technology commercialization. First, we call for an increase in the transparency of research resulting from federal funding through the creation of an "Innovation Exchange."

Second, we encourage federal agencies funding research to become more involved with driving university-specific improvements in technology commercialization. Third, we call for an increase in funding allocations for proof-of-concept centers and commercialization education programs through federal agencies funding research.

The Role of Universities

It has long been known that universities play an important role in economic growth, dating back to the 1800s when land-grant universities were created to provide skilled people and new research knowledge for a growing economy. The way we perceive and manage this role has changed, however. Universities now are expected to generate growth, rather than merely sustain or support it. They accomplish this through generating new knowledge, producing graduates, and licensing innovations—or actually creating new companies. Federal funding of research provides a critical base for most of these activities.

Universities' primary goals are, and should continue to be, the discovery and dissemination of new knowledge. But at the same time, universities are not monasteries. New knowledge for its own sake does not benefit human beings; it must be applied to real-world problems and challenges, and when this is done, the results must be disseminated to society. In market economies, dissemination often is best accomplished when innovations are commercialized, for it is the commercial infusion of human and financial capital that enables innovations to "scale," and thereby encourage economic growth.

Federal funding of university research has resulted in numerous and important commercial applications. For example, consider the list of the fifty most important innovations and discoveries funded by the National Science Foundation in its first fifty years, according to the NSF itself in 2000. Although this "Nifty Fifty" list includes some huge basic advances—such as the discovery that the universe is expanding at an accelerating rate—much of the list consists of innovations that have been

commercialized, or that have become platforms for many commercial products and services that are widely used today: barcodes, CAD/CAM software, data compression technology used in compact discs, and perhaps most significant of all, the Internet (which the NSF funded along with DARPA, the Department of Defense research agency). A recent Information Technology and Innovation Foundation report found that universities and federal laboratories have become more important sources of the top 100 innovations over the last thirty-five years. In 1975, private firms accounted for more than 70 percent of the R&D 100 (*R&D Magazine*'s annual list of the 100 most significant, newly introduced research and development advances in multiple disciplines), but by 2006, academia was responsible for more than 70 percent of the top 100 innovations.

Despite the significant social and economic contributions of university commercialization, there has been much discussion about polluting the waters of basic research with market principles, saying that an increased commercialization focus will negatively impact funding of basic research. Most of this concern comes out of a mythical view of the linearity of the innovation process. It is nearly impossible to draw lines around research activities and to predict which of them are "basic" and which "applied." But regardless of this enduring myth, I am not here today to advocate for a shift of research dollars out of basic research and into applied activities. Most federally funded university research is already supported precisely because it promises to contribute to a government mission, such as health, national defense, energy production, or environmental protection. In the life sciences, in particular, most research is conducted squarely in what Princeton University political science professor Donald Stokes termed "Pasteur's Quadrant," where research is both scientifically valuable and also immensely practical. We would argue that most efforts to increase commercialization can be achieved at relatively small marginal costs and can occur in ways that benefit both science and society.

In Search of Improved Pathways

The Kauffman Foundation has funded research focused on understanding the multiple pathways in which innovations are most effectively created and disseminated to the market, and we are not alone in recognizing the significance of this issue. In February 2010, Department of Commerce Secretary Gary Locke convened a meeting at the National Academies to open a dialogue with university and industry leaders focused on improving commercialization practices. On May 6 of this year, the Kauffman Foundation co-hosted the White House Energy Innovation Summit, which also focused on developing and accelerating new pathways to market—in this case, for energy innovation. And it is not just the Administration speaking out on this issue; university presidents and industry leaders are calling for new models and a review of practices in this arena. According to University of Arizona President Michael Crow, we must first design and implement new models of higher education to achieve the levels of connectivity, transparency, and speed of technology commercialization necessary to accelerate the innovation pipeline.[1]

There is much to applaud in the current system of federal research support and commercialization, but like any system or process, it can be improved. Indeed, the innovative process itself requires a constant lookout for ways to do better. We must remember that most technology commercialization programs on university campuses are relatively young in their tenure and, as such, can learn from the dissemination of best practices and the curtailing of operations that have inefficient scale potential. But before we get to best practices and issues of scale, I want to discuss several federal policy steps that could be taken to support improvement efforts on individual campuses.

First, federally funded research results must become more transparent and accessible. Open dissemination of research can significantly break down barriers that

[1] Summary Report of the White House Energy Innovation Conference, May 7, 2010.

exist between public and private researchers. Many existing academic and intellectual property protection norms do not support sharing the knowledge gained through federally funded research; this should be revisited. We need more efforts like the Public Library of Science (PLOS), which is a nonprofit organization of scientists and physicians committed to making the world's scientific and medical literature a freely available public resource, and the recent Yale Law School roundtable on "Reproducible Research: Data and Code Sharing in Computational Science." It is critically important to bring together legal, computational, life sciences, and scholars of other disciplines to propose frameworks and action steps that will enable access to future research, commercialization, and replicability.

As we move from discussing research to what could be considered innovations resulting from the research, separate platforms and standards for openness should be considered. The federal government should create an "Innovation Exchange" mechanism in the United States. Specifically, we believe the federal government should implement policy that requires all universities receiving federal funding to allow the outcomes of their research to become immediately accessible through a centralized clearinghouse. With experience, the Innovation Exchange platform can become a strategic advantage for entrepreneurs and companies, and therefore, support an accelerated economic recovery and growth.

Foundations are unique in that we pilot projects than can better humankind. Indeed, the Kauffman Foundation has studied and funded potential models of the Innovation Exchange like the iBridge Network (www.ibridgenetwork.org), which is currently a host site for more than 100 universities and 12,000 innovations. The iBridge Network was created to reduce the transaction barriers of commercialization and facilitate sharing across researchers, institutions, and non-profit and for-profit entities, while also shortening cycle time for commercialization transactions. The iBridge Network is an example of how pooling the pockets of knowledge that are currently held at individual campuses and creating transaction marketplaces that

span traditional geographic boundaries can lead to more social benefit. The iBridge Network was not intended as a final solution; as such, the Kauffman Foundation would be willing to provide all previous knowledge and intellectual property available to an appropriate not-for-profit or government entity that would be assigned the responsibility of managing an Innovation Exchange.

Second, we need to encourage the engagement of federal agencies funding research in university-specific evaluations of the effectives of the technology commercialization processes and policies as it relates to the disciplines and departments that receive federal funding. This review will be helpful in determining if departments and professors are advocates of institutional-specific changes to current technology commercialization practices. While university ownership of innovations, as specified in the Bayh-Dole Act, is a starting point for commercialization, to-date it has been an unfunded mandate and one specifically focused on licensing. Bayh-Dole does not specify the entire ecosystem required for commercialization. Elsewhere we have conceptualized some changes that could occur at the individual institution level such as allowing a free and competitive market in technology licensing. While allowing individual faculty or departments to choose their commercialization agents may not be a necessary requirement at every institution, like other free markets, an open system could dramatically speed up the commercialization of new technologies, ultimately benefiting consumers—in the United States and around the world—more rapidly. A free market directive also would likely lead university technology licensing offices (TLOs) to specialize or turn to outside agents with the appropriate expertise. A university might drop its TLO altogether, but continue to earn licensing revenues—less the fees charged by outside TLOs or agents. Federal agencies funding research need to be active in reviewing institution-specific technology commercialization practices from a discipline-specific perspective and driving adoption of new, more radical approaches at underperforming institutions. Performance should first be measured by innovations moved to the market, not revenue generated.

Increased funding to proof-of-concept centers and commercialization training/mentoring programs is the third area of policy relevance we see before the Committee. We know from individual-level studies of how technology commercialization practices change, that adoption of new practices is a person-to-person endeavor in most successful cases. If your mentor was good at technology commercialization, your graduate school advisor, or your current chair, then you are much more likely to engage in commercialization activities yourself. Unfortunately, most commercialization education programming is not systematic and hinges on the quality of "mentoring" received, or more accurately, how successful the mentors have been in building out commercial social networks. MIT Professor Robert Langer is the classic case study here, having mentored hundreds of graduate students and junior faculty who have been associated with his lab and gone on to significant commercial success.

The National Science Foundation has been the main federal agency to-date to provide commercialization education funding. While we applaud NSF's efforts, commercialization education needs to be ubiquitous (which it is not). The Department of Energy and the National Institutes of Health should require all principal investigators and graduate students who receive Clinical & Translational Science Awards (CTSA) or ARPA-E grants to participate in an approved commercialization program that would provide grantees access to detailed knowledge about intellectual property, market analysis, funding, and firm formation models.

Best Practices and Scale

Now that I have covered some of our specific policy recommendations, let me turn to the topic of best practices and scale. I bring up scale because I think one of the emerging understandings of the technology commercialization process is that individual institutions face enormous hurdles in recognizing and supporting commercialization efforts across all academic disciplines. Indeed, this is a challenge

that I would argue can be addressed by developing industry-specialized or discipline-specific TLOs, which will enable the TLOs to gain scales of efficiency in licensing. It also could mean that smaller research institutions would be best suited to consider regional or technology commercialization consortia rather than the maintenance of their own TLOs. Wisconsin implemented a similar statewide model a number of years ago, and both California and North Carolina have experimented with a variety of cross-university collaborations through their public university systems.

At many universities, a TLO becomes the de facto control center for the innovation strategy *of the whole university*. Faculty, who make inventions or discoveries, work through the licensing office, which is charged with a multitude of tasks—from determining commercial viability to patenting, licensing, and earning revenue. Many, but not all, of these offices are under-resourced for such a large agenda, and are in a constant push-pull based upon competing university priorities. In working with universities to address these topics, we learned of an underlying issue that may pose a greater concern: a tendency to focus on patenting and licensing to the neglect of other modes of innovation due to the competing concerns.

High-profile success stories have led us all to think of patentable technologies as the universities' primary form of innovative "output" to the economy, and of licensing as the main means of commercial diffusion. In fact, as innovation scholars have pointed out, universities have a range of valuable outputs—from "information," or knowledge, to human capital—and there are many possible pathways for diffusing them into the market: through consulting engagements, through non-patent-based startups, or simply through networking entrepreneurial students and faculty.

We see evidence that these outputs and pathways, if well-cultivated, can provide a significant new source of entrepreneurial outcomes in addition to patenting and licensing. For instance, many MIT students and alumni are prolific entrepreneurs and, in a program that serves them called MIT Venture Mentoring, the majority of the mentored companies do not hold intellectual property from MIT. Most of the

companies either are based on new business models to meet a need in a market, or they are software companies, which tend to rely less on patents. A replica of this model has been implemented in St. Louis, New Haven, and Toronto with some early visible success. Other areas, such as business plan competitions and industrial affiliate programs, show great potential impact, although they have not been studied much to-date. Patenting and licensing are certainly important, but a brighter future awaits universities and regions that, supported by resources across the campus and from a local entrepreneurial community, can tap the whole spectrum of innovation. As for incubators, there are times it makes sense to bring fledgling firms together to share lab facilities and services, and there can be synergies from the interaction. But, in too many cases, the incubator also is a real estate project that has to make real estate sense. If wet labs are needed, they can drive the costs quite high, and if filling the space becomes a concern that trumps serving the entrepreneurs, much of the value is lost. There are examples of successful incubators in places like St. Louis and Madison, Wisconsin; however, there are many more examples of failures. We should continue to learn from the successful incubators, while also considering new models.

One such new model, the proof-of-concept center, is seeing success, both as an incubator of early-stage ideas and as a way to provide students and faculty an opportunity to experience commercialization in a real sense. Proof-of-concept centers do not require shared physical space, but instead provide funds and expert assistance for early-stage innovators to test commercialization potential.

Many universities will be best served in expediting the transactional part of the processes in which they are involved. Here, “express licenses” are an emerging best practice. New examples of standardized licensing agreements, such as the University of North Carolina at Chapel Hill’s Carolina Express License Agreement or the University of Hawaii’s, bypass customized negotiations with the university, which can take considerable time with unpredictable results, in favor of clear, transparent, and timely license agreements.

The Carolina Express License Agreement is an example of how universities and entrepreneurs can streamline collaborations to facilitate the formation of new companies and jobs. The Carolina Express License Agreement was developed by a committee of UNC faculty entrepreneurs, venture capitalists, attorneys, and UNC's Office of Technology Development as a way to shorten the cycle time in which federally funded inventions move from lab to market in the form of a startup. Founders or entrepreneurs interested in starting a company can choose the Express License, which outlines provisions for company ownership, future revenue payments, and other common sticking points that can slow down commercialization. By creating a standardized licensing agreement, UNC departs from current commercialization guidelines issued by the Association of American Universities, which states that all technologies arise under unique circumstances and therefore require a customized licensing process. We must maintain universities' intellectual property rights while recognizing that technologies, innovations, and intellectual property are a small portion of what it takes to start an entrepreneurial venture.

A Call for Commercialization Education

The critical role that federally funded research plays in our economy is compromised because faculty, graduate students, and postdoctoral researchers do not have a base-level understanding of the commercialization process. The more than 48,000 postdoctoral researchers at United States institutions are at the forefront of new discoveries, but few have an opportunity to develop the entrepreneurial skills necessary to move their innovations from the lab to the market. With the aim of cultivating entrepreneurs from among the postdoctoral community, the Kauffman Foundation developed the Entrepreneur Postdoctoral Fellowship program to educate and train scientist-founders, who will create the high-growth technology companies of tomorrow. In our initial year, thirteen of the nation's top scientific postdoctoral scholars were selected to learn how to evaluate their research for commercial

potential and the process to take promising research forward to commercialization. Each Fellow has a business mentor, a customized experience, and intensive entrepreneurship workshops at the Kauffman Foundation, where they have the opportunity to network and learn from each other and from entrepreneur experts.

This is an area where federal agencies funding research could become involved. Indeed, NSF's rapidly expanding Professional Science Master's Program "prepares graduate students for careers in business, industry, nonprofit organizations, and government agencies by providing them not only with a strong foundation in science, technology, engineering, and mathematics (STEM) disciplines, but also with research experiences, internship experiences, and the skills to succeed in those careers." Until the Professional Science Master's programs take off and we see a reduction in the number of postdocs, the funding of more commercialization opportunities specifically aimed at postdocs would seem prudent.

The National Science Foundation has consistently expanded its efforts to encourage university and industry partnerships, and classic programs such as the Small Business Innovation Research grants. The Engineering Research Centers have been a cornerstone of the NSF portfolio and continue to be a wonderful source of basic research and corresponding commercial outcomes. Industry/University Cooperative Research Centers (I/UCRC) Program remains a relatively small but critical part of NSF's investments and is an increasingly important support mechanism linking new businesses with universities. The Kauffman Foundation and the National Academies have funded a myriad of studies to evaluate the effectiveness of the Small Business Innovation Research (SBIR) program. Simply stated, the SBIR program—specifically at the NSF—is a model program being replicated around the world. That being said, it is important to note that all SBIR programs do not have the same management infrastructure and capabilities. In the last two years the NIH has done a very good job of modifying the management of its SBIR program that today resembles the best practices of the NSF SBIR program.

The Case of Life Sciences

Thus far I have talked about technology commercialization broadly, and I now want to look specifically at one area—the life sciences—as it is an area of unique concern for me. A recent *Newsweek* cover story[2] summarized some of the main issues here very well, including:

- From 1996 to 1999, the U.S. Food and Drug Administration approved 157 new drugs. From 2006 to 2009—the agency approved 74.
- From 1998 to 2003, the budget of the NIH doubled, to $27 billion, and is now $31 billion.

The frustration around the slow pace of discovery to marketplace in biomedical research cannot all be attributed to the role of the university but, due to the significant role of the NIH in funding university research in this area, it should be considered. The “valley of death” between a basic discovery and the stage at which drug companies are willing to invest in the development of a compound is stopping many potentially high-impact innovations from reaching the marketplace. In this valley, academic scientists have few incentives to participate because academic publications and tenure processes aren’t supportive of the difficult and sometimes tedious testing work that is necessary to determine toxicity of a compound in animal subjects. Indeed, even some of the more informal disincentives of academia, which bias against publishing negative results, discourage researchers from working with compounds closer to human consumption.

Another challenging factor in drug development today is the fact that large drug companies have reduced their workforces by more than 90,000 employees in the last year as they change strategies on testing and development, choosing to outsource these functions more to biotech firms. But biotech firms are often

[2] http://www.newsweek.com/2010/05/15/desperately-seeking-cures.html

undercapitalized and the recent recession has not helped the situation. According to industry officials, the major source of funding for these activities in recent years, venture capitalists, have become much more reticent to support early-stage testing and translation service.

Getting new treatments and cures to patients more quickly is the goal of a unique life science proof-of-concept model that draws support from higher education, philanthropy, and industry experts to move medical innovations from the lab to the market. Earlier in this testimony we recommended the funding of proof-of-concept centers, two of which we evaluated in a report released in 2008. Since that time, the Kauffman Foundation sought to replicate the model with our own funding to prove the benefit of the model at a university that did not have the budget of an MIT or University of California-San Diego. The Institute for Advancing Medical Innovation, established at the University of Kansas with funding from the Kauffman Foundation, will focus on education and research that advances medical innovations, ultimately accelerating the number and quality of new drugs, medical devices, and drug–medical device combinations from the bench to the bedside. The grant earmarks funding for the Institute for Pediatric Innovation, which funnels its drug development work through a partnership with KU, Kansas City's Children's Mercy Hospital, and Beckloff Associates Inc. The Institute is guided by an advisory board of independent experts and staffed by experienced drug development and medical device leaders to create an unprecedented collaboration of resources and processes to support the Institute. The Kauffman Foundation grant includes seed funds for up to twenty-four proof-of-concept projects per year. Based upon the recommendations from its advisory board, the Institute may progress with a varying number of projects from year-to-year. In addition to its impact in the medical field, the Institute for Advancing Medical Innovation serves as a national model for how philanthropy, industry, and universities can collaborate to advance university innovations in life sciences.

These types of university, industry, philanthropy, and advocacy group collaborations have the potential to change the way in which basic discoveries are brought to market. I am particularly excited to see how these seeds of cooperation are being encouraged as a result of a large increase in funding in the recent healthcare legislation that will provide $500 million to the Cures Acceleration Network at NIH for such collaborations this year. However, the *Wall Street Journal* has reported that companies that are partially owned by tax-exempt organizations (like universities) will not be eligible for funding.[3] This exclusion of companies that likely have university equity seems like a counterproductive measure that will be a disadvantage to many startup firms that are based on university technologies.

Conclusion

There are no single models for success. We have highlighted some basic elements here, but they may need to be applied in different ways. What works best at each university may depend on its research strengths, the nature of the related industries, the nature of the region (big city, rural, etc.), and other variables. The only common thread is the need for a well-developed ecosystem of innovation. In high-growth regions with highly entrepreneurial universities, the following tend to be true of the faculty: They have frequent and extensive contacts with private industry, which attune them to thinking in terms of practical value creation while enabling them to share their own expertise. High-growth regions operate with university policies that encourage such activities, rather than laboring against policies that draw barriers between the academic and the commercial realms. Magic bullets may score occasional hits, but ecosystems flourish with many pathways to the commercial market.

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[3] http://online.wsj.com/article/SB10001424052748703559004575256303965700876.html

We call on you to increase the transparency of research resulting from federal funding through the creation of an “Innovation Exchange,” to encourage federal agencies funding research to become involved in institution-specific technology commercialization effectiveness reviews, and, lastly, to increase funding allocations for proof-of-concept centers and commercialization education programs.

Thank you for the invitation to present to the Committee today.