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Changes in academic entrepreneurship among  
Japanese university bioscientists, 1980-2012.

A dissertation submitted in partial satisfaction of the  
requirements for the degree Doctor of Philosophy  
in Sociology

by

Nahoko Kameo

2014

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## ABSTRACT OF THE DISSERTATION

Changes in academic entrepreneurship among  
Japanese university bioscientists, 1980-2012.

by

Nahoko Kameo

Doctor of Philosophy in Sociology

University of California, Los Angeles, 2014

Professor Lynne G. Zucker, Chair

The dissertation examines how Japanese university scientists in the biosciences responded to legal and institutional changes in academic entrepreneurship. Beginning in the 1990s, the Japanese government initiated a series of policy initiatives that attempted to imitate the U.S. academic environment's approach to promoting entrepreneurship. Using archival resources, interviews with prominent scientists, and quantitative methods, the study shows how Japanese university bioscientists responded to these policy and institutional changes.

The changes created a new environment. University patenting was encouraged, and collaborations with firms were presumed to have clear, formal contracts through university administration. Japanese university bioscientists, however, did not simply follow the new rules for academic entrepreneurship. Instead, they created a set of practices that were only loosely

coupled with the new rules. The study identifies two sets of conditions for the emergence and development of such practices: the scientists' previous practices, which fostered gift-exchange-like trust relationships with collaborating firms, and the scientists' transnational experience, which made them aware of the different possibilities and methods for commercializing their inventions around the globe.

The dissertation draws several conclusions. As I show quantitatively, the policy and institutional changes in Japanese academic entrepreneurship increased the number of university-firm interactions. However, as the interview-materials show, Japanese university scientists also maintained entrepreneurial practices that were not the intended consequences of the policy interventions, including collaborating informally and creating startups in the United States. The resulting structure of academic entrepreneurship in Japan, therefore, was a juxtaposition of its own old practices, new procedures, and opportunities abroad. In some respects, this new structure resembled the old structure more than the American one that policy makers had sought to imitate. By identifying ways that local actors can shape how policy is enacted at the local level, the dissertation complicates the current picture of the global diffusion of academic entrepreneurship.

The dissertation of Nahoko Kameo is approved.

Stefan Timmermans

Gabriel Rossman

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2014

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It was only when I became a parent that I realized what kind of leap of faith – and also pure sorrow – my parents in Japan must have experienced when they allowed their only daughter to go to graduate school in the United States. As I begin to establish my personal and professional life in the United States, I am still sorry that I'm not coming back to Japan. I can only hope that my Ph.D. and my ability to follow my own path will keep them proud of their adventurous daughter.

I came to the U.S. with one small suitcase but as I stayed the baggage grew bigger and bigger. During the seven years I devoted to my graduate training, I got a partner and then a daughter, Iddo and Eliana Tavory. They are simply the best, and I owe both of them so much for the inspiration they gave me. Iddo read so many versions of each chapter of the dissertation, and offered incredible amounts of emotional and intellectual support so I could actually finish the dissertation. The dissertation is dedicated to him.

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# **Introduction**

Academic entrepreneurship—economic pursuits based on university professors’ research and innovation—is actively studied in multiple disciplinary settings: economics, public policy, management, and sociology. In this dissertation, I crosscut some of these disciplinary boundaries to answer the following question: What does the rise of academic entrepreneurship mean for scientists’ practical action?

Universities have often been described as ivory towers, but if that characterization was ever true, it was only true in England until the early nineteenth century. Since that time, universities have always dealt with this-worldly concerns over providing higher education for a quality workforce and providing a base for national scientific and technological advancement. That being said, until the late twentieth century, universities weren’t supposed to drive economy itself. In the late 1970s, however, the relationship between university and commercial activities shifted. These shifts were especially pronounced in the field of biotechnology. After breakthroughs in DNA recombination technologies, the life sciences shifted from being a quiet university research environment to being the point of origin of most scientific entrepreneurship. Policy soon followed to support the institutionalization of this change toward a more entrepreneurial academia. By the end of the 1980s, in the United States, entrepreneurial activities—from licensing innovations to establishing startups—became an essential part of the professional lives of university scientists (Krimsky 1991; Zucker et al. 1998).

There are many ways to approach this change. One can, for example, try to estimate the rising economic impact of academic knowledge production (Henderson 1998); study the potential dangers of the increasing interdependence between academics, policy makers, and industry

(Slaughter and Rhoades 2009); argue about the emergence of a new, networked way of producing and capitalizing on knowledge (Powell et al. 2004); or delineate the historical process by which the entrepreneurial university was created (Berman 2012). The approach taken in this dissertation was to look at the university scientists themselves. I focused on a rather specific set of scientists: Japanese university bioscientists. I chose to study individual scientists because I have theoretical interests in the interrelationship of institutional and organizational change and in local negotiation of workplace practices. I chose to study Japanese scientists because ongoing changes in practices of academic entrepreneurship in Japan provided me with an interesting case to work with. Unlike the United States, where the institutionalization of entrepreneurial academia evolved gradually from internal changes in academia, industry, and policy, the change in Japan was brought by government intervention, which was largely external to what was happening in Japanese academia and its interactions with industry.

The global institutional shift toward a more entrepreneurial academia might initially be conceived as an external shock to Japanese university scientists: the shift originated in the United States, where the economic success of faculty inventions prompted formalization of university-industry interaction. Japanese academia had its own approach to university-industry interaction, based on an informal system of donations, so an internal need for change did not seem to be paramount. In other words, without any foreign influence, it seems unlikely that Japan would have reached the same legal and organizational conclusions and implemented formal mechanisms of university-firm collaboration. But change did not completely come out of the blue either. Japanese academia *is* a part of the global academic community, and Japanese

scientists are exposed to the changes in the United States on an everyday basis. In some sense, there is no such thing as a Japanese scientific community—science and (therefore) scientists have no national boundaries. So, while Japanese universities have distinct institutional and cultural legacies, they are also always looking at and learning from the way academia is organized in other places, especially the United States and Europe. Thus, by studying Japan, I am also studying globalization and its consequences.

Concretely, I detail how the Japanese government recognized Japan's relative tardiness in academic entrepreneurship and implemented various policy changes to encourage entrepreneurial activities. A list of all the initiatives is in Table 1, but I'll highlight a few of them here. In 1999, Japan passed the Japanese Bayh-Dole Act,—the equivalent of the U.S. Bayh-Dole Act, which allows universities to be patent owners of the findings of nationally funded research. In 2001, this was followed by an ambitious intervention designed to develop startups with university-produced scientific knowledge. Then, finally, The National University Corporation Act of 2004 allowed national universities to freely develop their own strategies regarding university-industry collaboration. Such measures were primarily and explicitly modeled on the commercialization environment of the United States. Japanese university scientists thus had to adapt to a new policy and institutional environment that was intended to “Americanize” Japanese university-industry interactions.

In *Imitation and Innovation*, Westney (1987) looked at how Meiji Japan imported and emulated Western organizational models during its rapidly modernizing era of 1870–1920. Westney investigated Japan's adoption of U.S. police, postal, and newspaper systems. Westney argued

that we must go beyond the paradigm of “the Japanese tradition versus Western rationality” (p. 223) to understand how the resulting organizational patterns differed from the original models. Emulation was selective in each case; because of differences in resources and environment, it was impossible to completely bring over the original organizational patterns. Moreover, local actors reshaped traditions to “fit the needs of the organizations” (p. 219). In other words, there were “pulls” from both sides: the Japanese tradition and resource problem pulled the new system to accommodate the Japanese environment, and Western models pulled available Japanese practices to shift and serve the new organizational form.

The metaphor of “pulling” is a useful way to think through the case of academic entrepreneurship. The Japanese government, for example, did not completely change the national university system. And local actors looked for ways to use their established resources, networks, and practices in the new system. The result was the familiar “same but different” theme of globalization/glocalization that we see around the globe. The case at hand has two additional forms of complexity: there was already a working structure for the same institution—academic collaboration with industry—before the emulation, and the world is now even more globalized than it was during the Meiji period.

The “pull” toward the existing Japanese model was thus stronger and more complex in the sense that the local actors didn’t have to craft new repertoires of entrepreneurial action from scratch. They already enacted and were deeply immersed in practices that Japanese university scientists have been engaged in for more than thirty years. Also, local actors in the 1990s and 2000s were much more exposed to the world outside Japan than they were in the Meiji period, when



international exposure was costly and limited. The current, more globalized world created a set of actors—Japanese university scientists—who constantly traveled to, worked with, and sometimes belonged to Western (and particularly American) academia on a very personal level. This made them a specific kind of actor: they were cosmopolitan in orientation, they possessed transnational repertoires of action, and sometimes, they were strategic enough to avoid binding themselves exclusively to Japanese academia and its regulations and practices.

To understand the impact of the rise of academic entrepreneurship and its formalization on how Japanese scientists go about their work, the dissertation starts with a description of how Japanese scientists worked with industry before the introduction of the new system. Chapter 1 delineates the mechanisms of loose coupling between what Japanese university scientists were supposed to do after the policy changes and what they did do. As expected, Japanese university scientists did not rigidly follow the new rules and completely abandon the way they used to work and collaborate with industries. Chapter 1 describes the gift-exchange-like trust relationships that Japanese university scientists maintained with firms before the introduction of new rules. In this informal arrangement, scientists worked with firms without contracts, accepting “donations” and providing “favors” in the form of intellectual property rights. After the introduction of formal rules, scientists avoided breaching such social ties and expectations of reciprocity. Thus, scientists created loosely coupled practices that are quite similar to the old, informal practices. They did this by neglecting, partially following, or negotiating within the new rules. I specify how this loose coupling between formal rules and work activities unfolded: local actors

reappropriated the new system and “pulled” it closer to the old set of practices so they could sustain the relationships in which they were already enmeshed.

In chapter 2, I look at how the transnational experience of Japanese university scientists shaped the ways they responded to changes in academic entrepreneurship. Choosing a policy is increasingly a globalized affair, in that countries tend to imitate the policies of whichever country is deemed superior in that policy domain. But local actors, who then have to deal with the real-life consequences of that policy adoption, are also globalized, in that they travel beyond national boundaries—as do resources and ideas, even in the rare cases when local actors do not. I show that the Japanese university scientists were “cosmopolitan,” in that they already had extensive knowledge of and experience with the “American way” of engaging in academic entrepreneurship. They had acquired this knowledge and experience well before the changes took place, either by working in the United States themselves or by working with U.S. scientists and firms. Some scientists were already fluent in the U.S. style of academic entrepreneurship. Consequently, few of them entirely abandoned the old informal practices. In most cases, Japanese university scientists experienced the new rules through a transnational perspective that they already possessed and that was not a simple matter of them being “more Americanized.” Because they enjoyed having multiple pathways to academic entrepreneurship—for example, working with Japanese firms informally while also establishing a startup in the United States—they did not necessarily adopt one set of rules or another. Rather, scientists avoided committing to any particular commercialization environment and instead purposively selected resources, regulations, and opportunities across national boundaries.

The third chapter shifts focus from how bioscientists responded to the changes to how their patenting and publication behavior changed. To understand whether and how academic entrepreneurship has changed the way scientists commercialize their research, it is not enough to examine their narratives and recollections. Thus, whereas the first chapters heavily rely on in-depth interviews with scientists, the third chapter examines numbers of publications and patents. I used COMETS database to find information about scientists' publications, copublications with firms, patents that list the scientist as an inventor, and patents for which firms are the assignees. I use this data to examine the effects of the measures that the Japanese government adopted to promote university-industry interaction and academic entrepreneurship. The results indicate that the Japanese Bayh-Dole Act and other policy initiatives did influence the scientists to collaborate with firms and to more actively seek intellectual property rights.

What ties the three chapters together is their shared focus on individual action in the face of large-scale institutional and organizational change. Instead of looking at the institutions and organizations to answer questions about change, I wanted to build an explanation of change by delineating the processes through which local actors understand, negotiate, and respond to change. Whether we call the deviation from the original "innovation" or "decoupling" or even "failure," local actors ultimately hold the key to understanding how imported and imitated institutional and organizational patterns become embedded in the adopting society. The Japanese university scientists I studied were active participants in creating the new, compromise (or hybrid), structure of academic entrepreneurship. Japanese university bioscientists responded to

the policy initiatives and increased their engagement with industry but did so largely on their own terms.

Taken as a whole, my dissertation answers questions about how Japanese university bioscientists have organized their working lives at a time when Japanese academia is shifting drastically to be more commercially oriented. More generally, it also helps us think about globalization, world society, and the notion of decoupling: how diffusing policy initiatives shape repertoires of action in ways that both subvert and transcend legal change.

**Table 1. Major Policies related to Innovation, Academic Entrepreneurship and National University Regulations**

Year (enacted)	Name	Official name, if different	Summary
1995	Science and Technology Basic Law		The law launches a series of effort to "achieve a higher standard of science and technology, to contribute to the development of the economy and society of Japan".
1998	The TLO Act	Act on the Promotion of Technology Transfer from Universities to Private Business Operators	Government supports establishment and maintenance of accredited technology licensing organizations.
1999	The Japanese Bayh-Dole Act	Act on Special Measures for Industrial Revitalization	
2000	Industrial Technology Enhancement Act		Widened allowed types of partnerships between TLOs and universities; allowed national university faculty's further involvement in technology transfer (e.g. being on a board of directors)
2001	Hiranuma Plan	Executive Plan for Creating New Markets and Employment	Government targets 1,000 startups to be established by university inventions
2003	Intellectual Property Basic Act		Defines Universities as a place to create intellectual property in the society and requires them to actively and voluntarily produce and disseminate research and its fruit

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## **Chapter 1**

### **Gifts, Donations, and Loose Coupling:**

### **Responses to Changes in Academic Entrepreneurship Among Japanese Bioscientists**

## **Introduction**

This article traces the processes by which local practices change when their institutional environment changes. As Meyer and Rowan (1977) stipulated, formal structures and actual practices necessarily decouple. And yet, the role of local actors in such processes is less clear. How do old relationships and ways of working influence the ways that actors interpret, negotiate, and enact new formal systems? This paper draws on a case of legal and institutional changes in academic entrepreneurship in Japan to illustrate how the past seeps in during the creation of new, decoupled practices under new formal rules.

Empirically, I follow the Japanese government's introduction of measures to encourage academic entrepreneurship during the 1990s and 2000s. These measures sought to change the nature of interactions between scientists and firms from an informal gift-exchange system to an American-style model based on formal contracts. This effort led to drastic changes to the policies that regulated the commercialization of university-based scientific findings. Before these changes, university scientists worked in a *laissez-faire* environment that allowed them to commercialize their inventions informally. This system contrasted with that of the United States, in which the biotechnology industry in particular had benefited from more systematic, formalized, rules that regulated intellectual property (IP) management and technology transfer



and encouraged universities to collaborate with industries. The success of this U.S. model prompted Japan and other countries to emulate U.S. structures of academic entrepreneurship.<sup>1</sup>

Despite significant differences in local situations, the Japanese government explicitly imported the U.S. structure of commercialization—a perfect example of the kind of institutional isomorphism that institutional sociologists have long theorized (DiMaggio and Powell 1983). The new system was explicitly modeled on the United States, to the extent that, for example, the law to enable universities and other private entities to own intellectual properties (IPs) arising out of nationally funded projects is commonly referred to as the “Japanese Bayh-Dole” act. In addition to the Japanese Bayh-Dole act, the Japanese government established technology transfer offices; encouraged formal, contracted, collaborative projects between universities and firms; and gave national universities—which produce 90% of the research—“corporation status” so they could manage interactions with industry without restrictions due to their status.

Using in-depth interviews with Japanese university bioscientists, this study delineates how Japanese university scientists interpreted and responded to these legal and institutional changes. The scientists all seemed to agree that Japan in theory needs systematic pathways for academic entrepreneurship to replace the old, informal practices by which academic scientists interacted with industry. In practice, however, scientists followed the new rules only partially. Many of them tried to keep particular informal practices, such as the practice of using donations for collaboration and giving intellectual property (IP) rights to the collaborating firm. When they

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<sup>1</sup> I define academic entrepreneurship broadly to include any of the following: collaborating with nonacademics on research, patenting and licensing; establishing a firm based on university-based research; and joining research centers or consortia involving firms.

deemed it impossible or overtly illegitimate to practice these informal arrangements, they worked to use the new rules in ways that would approximate the previous, informal arrangements. Thus, scientists, for example, would negotiate with their university's Office of Research for *the firm's* IP rights, or they would start joint research without a formal research agreement and then go through the formal procedures later only if the collaboration seemed likely to be long and successful. The resulting set of practices for academic entrepreneurship thus ended up resembling previous Japanese informal practices more than the adopted U.S structure.

I begin the following discussion by explaining how Japanese scientists negotiated new work practices after the adoption of U.S.-style academic entrepreneurship. I then develop theoretical propositions to conceptualize how the practices local actors were engaged in before the change influenced the way they created new practices under the new rules. Empirically, this case helps clarify the real impact of the institutionalization of “science as economic engine” in the global science community (Berman 2012). Recently, scholars have attempted to strengthen the theoretical underpinnings of institutional theory by paying more attention to the intricate work that actors in organizations engage in to create micro-practices that create and sustain institutions—what Powell and Colyvas (2008) call “enaction, interpretation, translation, and meaning” in organizational life. I build on such efforts to “inhabit institutions” (Hallett and Ventresca 2006b) by building a set of propositions to conceptualize how the local, informal practices embedded in social relations influence the ways that local actors negotiate new practices.

In the Japanese case, informal relationships between individual scientists and firms governed the practices that were in place before the adoption of the formal rules. These practices resembled a gift exchange (Bourdieu 1977; Mauss 1954) based on trust: the scientist offered the firms collaboration and the fruits of the research (typically as IP), knowing that sooner or later, the firm would respond with donations. After the implementation of the new rules, this gift exchange could no longer work because scientists could no longer offer firms a near-exclusive use of the IP that resulted from their collaboration. As a result, scientists chose one of two options: (1) they resorted to the previous arrangement of working informally and handing over IPs even though it was now a legally dubious practice, or (2) they followed the new formal procedures but tried to replicate the prior arrangements as much as possible by negotiating the terms of the formal collaboration agreement with university's Office of Research. Thus, I offer the theoretical proposition that when previous arrangements involve informal, gift-exchange like practices, the old practices "pull" the new emerging practices into old patterns. This is not only because the old practices cognitively "make sense" (Labianca et al. 2000; Reger et al. 1994; Weick 1995) or are practically better for meeting work requirements (Meyer and Rowan 1977). Rather, it is because of the strength of the relationships between the actors. When the old micro-practices are embedded informally within the network of actors, the actors try to avoid breaching the established relationship by "pulling" the new practices toward the old practices.

## **Theoretical background**

The recent involvement of university scientists in the commercialization of knowledge is far beyond what Merton (1973) would have expected from a scientific community that rewards openness and selflessness. By now, it seems safe to say that universities have embraced the role of economic engine; this is certainly true in the United States, but also in many other countries with strong science and technology sectors. University scientists engage in academic entrepreneurship, and by and large, they find it unproblematic. The transformation of university from the place of knowledge production to the place of knowledge production *and* economic engine (Berman 2012) was a result of actions and interactions among academic scientists, policymakers, and industry leaders in the United States between the 1960s and the 2000s (Berman 2008, Colyvas 2007; Etzcowitz 1983, 1998).

With the successful institutionalization of commercially oriented academia in the United States, other countries followed suit—a prime example of the diffusion of formal structures (Meyer and Rowan 1977; DiMaggio and Powell 1983). According to the Association of University Technology Managers, many European countries, as well as Brazil, China, South Korea, and Japan, have now passed a law equivalent to U.S. *Bayh-Dole Act*, which enables universities to retain intellectual property rights to inventions funded by federal or national agencies. Such a process gives rise to a plethora of questions: Do the practices of scientists around the world really mirror those in the United States? How do practices in different countries vary? How does the diffusion of the U.S. model affect academic entrepreneurship in the adoptee countries and the global scientific community?

Studies of academic entrepreneurship in the United Kingdom, Italy, and Japan seem to support the hypothesis of Americanization quite well. Each of these countries is seeing more faculty members engaged in entrepreneurial activity, more university patenting, and more university startups (Geuna and Rossi 2011; Lam 2012; Shibayama 2013). But a deeper look also reveals considerable variation. Although many countries have adopted the U.S. model of academic entrepreneurship, there seem to be important differences in how this model is understood and practiced in different countries. To understand the global institutionalization of the “university as economic engine,” then, requires researchers to look at how local adaptations of the U.S. structure diverge from one another to create different institutional patterns and practices of academic entrepreneurship.

Institutionalism offers theoretical insight regarding local variations of a common formal structure. Organizations become isomorphic, especially in uncertain environments, because they seek to gain legitimacy (DiMaggio and Powell 1983; Meyer and Rowan 1977). But this diffusion of legitimated formal structures is accompanied by a decoupling of rules and practices at the local level: “Because attempts to control and coordinate activities in institutionalized organizations lead to conflicts and loss of legitimacy, elements of structure are decoupled from activities and from each other” (Meyer and Rowan 1977: p. 357).

As some organizational sociologists have focused on the human actions that create and sustain institutions (see also Barley 1986; Barley and Tolbert 1997), they have begun to ask about the local, micro-level, accomplishment of such decoupling. Such a micro-institutional perspective is developed in the recently burgeoning literature on “inhabited institutions” (Hallett 2010).

Inhabited institutionalism reorients scholars to social interaction and its generative role in meaning making, and to the ways that interactions sustain or change organizational structures and practices (e.g. Hallett and Ventresca 2006a; 2006b). As scholars focus more on interaction and negotiation at the local level, they have reconceptualized decoupling as “loose coupling”—organizational actors’ temporal, coordinated accomplishment of relating to formal rules with varying degrees of exact compliance (Hallett and Ventresca 2006a). Thus, decoupling does not mean a complete lack of relationship between rules and practices. Rather, it indicates a flexible relationship in which practices are somewhat responsive to rules but are also distinctly different from “the way it is supposed to be on paper” (see also Orton and Weick 1990; Weick 1976). Several studies have highlighted the agentic role of local actors in figuring out how to understand, respond, and then even ignore or modify the adopted structure is well depicted in such studies (Berman 2012; Coburn 2004; Hallett 2012; Turco 2012). Actors in organizations must create the linkage between micro-practices and formal rules by interpreting the new environment and creating new micro-practices, and this creation is the key to institutionalizing new rules (Coburn 2004; Hallett 2010).

My research joins the inhabited perspective by depicting the active role of actors’ understanding of the social ties and practices on the way they loosely-couple and distinguish work practices from the new rules. This is particularly salient in the case of the Japanese biosciences, where old practices had sustained an protracted gift relationship (Mauss 1954) to informally manage collaboration with firms. For scientists, these informal scientist–firm interactions had multiple moral, relational, and economic implications. To understand these implications, it is useful to

employ the idea of embeddedness first developed by Polanyi and later popularized by Granovetter (1985). Social relations specify both the means and the meaning of economic transactions (Zelizer 1989), and as Krippner (2001) elaborates, the key insight of embeddedness concept is that economic actions are situated in concrete institutional settings, and there are no economic actions that can be separated, and abstracted from their institutional and cultural contexts. One action can constitute *both* gift and market-exchange *at the same time* (see, e.g. Lainer-Vos 2012).

I use this insight to show that the previous Japanese collaboration practices between university scientists and firms must be understood as carrying multiple meanings and transactions. These practices were simultaneously means of promoting scientific endeavor, commercializing academic findings, gaining monetary rewards, and, crucially, maintaining personal relationships with firm scientists. The informality of collaboration enabled scientists to maintain gift-exchange-like practices. Often, the monetary rewards for collaborations and IPs were not specified in detail and were delayed. The new rules, by contrast, forced scientists to engage in clear, contracted market transactions. The rules dictated that the scientist and the firm must have a formal contract that specified compensation for scientific work and the use of IPs, which in turn implied a different kind of social relationship: that of calculating strangers in a market exchange (Callon 1998). Thus, the reappropriation of new rules—and the creation of new, loosely coupled practices—may be motivated by actors who wish to maintain the same kinds of relationships that they had before the rules were instituted. To understand and trace the processes

of loose coupling, it is crucial to trace the relationships that actors are embedded in, as well as the pressures and opportunities afforded by these relationships.

## **Data and Methods**

The study is based on archival research and forty in-depth interviews with prominent Japanese university scientists in the biosciences, as well as five university administrators involved in university-firm collaboration or technology licensing and two firm scientists who had worked with university scientists and policy makers<sup>2</sup>. Some scientists also held official administrative positions, for example as a board member of the Council of Science and Technology Policy, in which case I also asked them about their administrative work. I used archival materials to understand the historical background and meaning of the new policies on commercialization. These archival materials included the official policy notice and other documents from the Ministry of Education, Culture, Sports, and Science & Technology (referred to as MEXT); the Ministry of Economy, Trade, and Industry (MITI); the Ministry of Health, Labor, and Welfare (MHLW); and their related semi-governmental organizations (Japan Science and Technology Agency, New Energy and Industrial Technology Development Organization, and Pharmaceuticals and Medical Devices Agency, Japan). These semi-governmental organizations implement government policies by administering grants, regulations, initiatives, and other policy-related issues.

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<sup>2</sup> For purposes of this article, the biosciences include biology, chemistry, and medicine (Zucker and Darby 2007).



The main data used for the analysis come from interviews conducted between 2010 and 2012. I selected university scientists who are highly successful and influential. Commercialization policies target those high-profile scientists because they are the ones who can potentially create the Japanese versions of Genentech or Chiron—biotechnology startups involving academic scientists that became extremely successful; commercialization is most successful when “star scientists” from academia are involved in the process (Zucker et al. 2002). Moreover, studies show that actors and institutions with strong reputations influence others to accept new practices and institutional logics (Stuart and Ding 2009; Owen-Smith 2011). Thus, I chose ISI Highly Cited scientists, as well as other influential scientists who worked at one of Times Education’s two hundred World Top Universities between 1990 and 2010 and who are also engaged in commercialization activities. Their level of commercial involvement varied from having a co-publication with a firm (signaling that they interact with firms) to having their own startups. Additionally, I interviewed policy makers, administrators of universities’ Offices of Research, university technology-transfer office personnel, and firm scientists. To maintain confidentiality, this article only mentions interviewees’ positions and general areas of research.

I implemented an ethnographic interview method (see Spradley 1979; Weiss 1994) designed to generate understanding of participants’ perspectives and sequences of action. This method is particularly well-suited for this research because it requires interviewees to specify the actual processes of their work and the history of their involvement with commercial firms and/or their own entrepreneurial activity as their career has proceeded and in the context of shifting national policies, university regulations, and departmental cultures. Interviews lasted between 60 and 180

minutes. All interviews were conducted in Japanese, and the quotes were translated by the author. I recorded and transcribed all interviews and analyzed all transcripts and documents using a modified version of “grounded theory” (Glaser and Strauss 1967; see Timmermans and Tavory 2007, 2012). I systematically coded the interview notes and archival materials, allowing themes to arise inductively, but also attended to literature on practice change in organizations, science and technology policy, and institutional theory. I thus recursively moved between data and relevant theory.

### **Legal and institutional contexts of Japanese Academia, 1960s -- 2000s**

Since the 1950s, Japan has experienced a proliferation of research activities in science and technology. However, during the 1950s and 1960s, Japanese scientists seldom commercialized their findings. The only way that firms could establish a relationship with a national university was to donate money to the university. Called “Syougaku-kifu,” literally meaning “scholarship support for study,” this practice consisted of a donation to national universities by private firms or individuals for the purpose of supporting academic research. The Syougaku-kifu scheme started as early as 1964 (Ministry of Education 1964) and allowed firms relatively informal access to university scientists. Because Syougaku-kifu was defined as a donation, donors could not legally specify the purpose of its use. Crucially, however, they could specify which professor’s lab the donation would be forwarded to. The flexibility of donations led firms and

scientists to use them for informally agreed-upon purposes – such as sponsored or collaborative research.<sup>3</sup>

During the 1980s, the Japanese government gradually crafted official, and thus more formal initiatives for university-industry cooperation. In 1983, the government established a scheme for collaborative research between universities and firms; before that, it had only allowed contracted research that had a clear public benefit. Administrative offices for collaboration were established at public universities beginning in 1987. During that time, the Syougaku-Kifu “donation” scheme simultaneously functioned as a way for university scientists to informally collaborate with firms.

Research on Japanese university-industry interaction provides ample evidence that collaborations before the introduction of Japanese Bayh-Dole and related measures were usually handled informally (Branscomb et al. 1999), sometimes by "working around" institutional arrangements that formally did not quite presume their existence (Zucker and Darby 2001). After the policy changes of 1983 and 1987, scientists could have official joint research approved by their department, especially when there was a grant involved. But informal collaborative projects were far more ubiquitous and were generally seen as legitimate.

Part of the reason for such informality resides in the structure of IP rights regulations: Before 2004, there was no technology-transfer office for scientists to consult with when they developed

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<sup>3</sup> In Japanese university terminology, there are two kinds of collaborations: sponsored research and commissioned research. Sponsored research does not involve the active participation of the firm in research itself, whereas commissioned research usually involves both parties engaging in research. In this paper, I use “collaboration” or “collaborative research” for both types of university-firm interactions.

inventions.<sup>4</sup> In contrast to the restrictive rules for “national inventions” arising from commissioned research and grants-in-aid, the treatment of inventions arising from faculty members’ own research – including the research that was part of an informal collaboration – was enacted within a laissez-faire environment.<sup>5</sup> The IP rights of inventions arising from university scientists’ research belonged to the scientists, whether the research was part of normal academic activities funded by faculty research allowances or part of an informal collaboration between a university scientist and a firm. Per 1978 notification, scientists could do as they saw fit with their rights over their inventions (Ministry of Education 1978).<sup>6</sup> Thus, by using donation scheme, university scientists could routinely give away the IP rights of any inventions to the collaborating firms. Since scientists normally did not wish to patent their inventions out of pocket, and there were no university technology-transfer offices that would consider patenting, the unofficial, informal route was an easily accessible way to secure patents (see also Kneller 2003).

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<sup>4</sup> Although the Japanese Bayh-Dole has been in effect since 1999, and TLO law went in effect in 1998, technology transfer through TLO started to burgeon only after the enactment of the National University Corporation Act in 2004, from when national universities could claim the IP rights of their faculty members without it being national inventions.

<sup>5</sup> In terms of intellectual property rights, before the changes this study focuses on—which took place between 1998 and 2005—there were no definitive laws that governed university-based inventions. Instead, several Ministry of Education guidelines governed the IP rights of university-based inventions; these guidelines were published as “notifications.” (The Ministry of Education was later restructured as MEXT – Ministry of Education, Culture, Sports, Science and Technology). Notifications served as guidelines for universities to follow, and later notifications could amend earlier notifications. Weaving through the exact ramifications of such notifications is beyond the scope of this article (but see an excellent review in Kneller 2003). As a general rule, however, the laws designated as “national inventions” those inventions that arose from “commissioned research,” which included government-funded research and formally contracted industry-university collaborative research. However, the law allowed the funding firm to own up to 50 percent of the rights if they clearly contributed to the invention. If the commissioned research was funded by firms, the allocation of IP rights was more complex: the inventions had to be reported to the university’s Invention Committee, and the inventions were, as in general principle, considered “national inventions,” although it was possible to use contracts to arrange for the firm to fully or partially own the IP rights (Kneller 2003). For inventions arising from grants-in-aid, the treatment would vary depending on the funding ministry’s regulations.

Interviews confirmed that donations were routinely used for creating relationships between a university scientists and firms. All scientists interviewed who were active before the 1990s said that they had received Syougaku-kifu. A senior professor in biomedicine said:

We got Syougaku-kifu money – this is rather personal – we were close to the chair of a firm’s lab, so we’d ask and they gave it to us. That was when there were no restrictions on how to use the donation – they’d submit the money to the nation, but the whole amount would come directly to our lab. We could hire people, buy instruments, whatever. Before, people were doing [gesturing money under the table] so they [policy makers] created this. This system is still working.

As this excerpt exemplifies, Syougaku-kifu was often given by personal friends working in firms; these friendships had often been formed through networks developed through graduate education or conferences. Although Syougaku-kifu is formally a donation and, strictly speaking, cannot be used for funding specific projects, it was widely understood and operated such that the funding firm would receive pre-negotiated returns. Most commonly, firms would ask scientists to serve as their informal consultants regarding scientific questions, to introduce the best students in the lab to the firm when they went on the job market, and plug them into international scientific networks. Famous or “hot” researchers received donations from dozens of firms for networking purposes, and these donations directly benefited scientists’ research labs (also see Kneller 2003).

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<sup>6</sup> Because universities and the government almost never used the inventions themselves, it was thought best to leave them in the professor’s hands.

Although Syougaku-kifu was formally a donation, due to its flexible nature, it was also widely used as a method of payment for collaborative research. The professor and the firm usually exchanged a memorandum regarding a nondisclosure agreement, but many conditions of collaborative research were kept open. The amount that a firm donated to any one lab usually ranged from \$5,000 to \$30,000. Scientists were often happy to work on a collaborative project with this relatively moderate amount of money because donations were essential to the operation of the lab. These donations provided money that came with very few restrictions. The scientists told me, for example, that because MEXT's grants-in-aid did not use to allow granted funds to be used for international travel, they typically used donations to cover international conference expenses.

It was often expected that if collaborations yielded patentable findings, all, or at least a part, of the IP rights would be released to the firm who donated money for the project. Scientists routinely gave IP rights to donating firms, remaining only as "inventors" while the firm filed for the patent. Scientists could, in turn, expect larger donations when commercialization proved viable, or continuous small donations even when there were no collaborative projects going on. When I asked a university professor about "royalties" under the old system, he replied:

This is hypothetical, but we have the world of "duty and obligations" (giri-ninjyo). For example, they may donate \$50,000 next year even though we have no research. They may give us favors in other ways. The biggest thing for me is that once we build a trust relationship, they'll bring research projects one after another.

This professor's lab never claimed IP rights when the invention came from collaborative research; the professor was listed as one of the inventors, but the right of being assignee – and thus the right to exclusively use the invention or license it out—would be handed to the firm. By using the term “duty and obligations,” *giri-ninjyo*, often used to describe the code of conduct in premodern samurai relationships, the professor indicated that collaborative projects are based on trust. Both scientists and firm interviewees often invoked “trust” as the key to these informal collaborative practices. By using this term, the scientist signaled that he was happy with the old arrangement because he believed that if he gave the firms favors, the firm would return the favors; once the invention turned out to be useful, the firm would reward him in ways other than royalties from patent licensing.

Also note that the interviewee explains that monetary transactions are only a part of the rewards of the old system; he says that having a succession of collaborative projects and maintaining the relationship itself are also important to him. The “biggest thing” for him was, in fact, that the firm will keep bringing projects. The relationship described here closely resembles a gift relationship (Mauss 1954). Once one enters the gift relationship, the pair is bound by the expected reciprocity and sense of gratitude – in contrast to the formalized, contract-based collaborations with industry that the U.S. model promotes. “Trust,” “gentleman's agreement,” and “familiar” were words that scientists often used to talk about the old practices. One professor at a private medical school compared the (old) Japanese way with the foreign approach:

Japanese university professors and firms both are “familiar.” [He said the word in English.] Like a family, they aren't used to having contracts and deciding that if

something (valuable) comes up, this is the way we deal with. There are a lot of breaches of contracts, as the professors tend to sign whatever without carefully understanding what it is they are signing. When they go abroad, it creates confusion, like, “You’ve signed this contract AND that contract [that contradict each other]??” I’ve seen a lot of such cases. They aren’t used to contractual society. No training about that either, so it’s like working with neighbors here. Though, that might be an advantage – if it really works, I’d think we could collaborate with firms in a real sense.

This prominent professor, who was educated partly in the United States, compared the Japanese practices of collaboration with those of the United States. He explained that Japanese scientists are often naïve about managing university-firm interactions contractually. He also emphasized the relational and scientific aspects of doing research with firms; working with these firms is like working with the family and that if one manages to work that way, the scientific collaborations might succeed “in a real sense” – that is, they might lead to scientific discovery or drug applications.

In summary, the collaboration between university scientists and firms has multiple aspects: it consists of creation and exchange of scientific knowledge and resources, favors, intellectual property, and money. The relationship between scientists and firms was characterized by non-contractual reciprocity that resembled a gift exchange. Scientists would receive donations from firms, and in exchange, they would often “give” the firm IP rights, trusting that the firm would give them appropriate returns despite the lack of legal obligations to do so. Alternatively, scientists could, and in some cases did, opt for more formal arrangements that specified services



and rewards. But such negotiations were relatively uncommon and depended on individual scientists' initiative; most scientists did not take up formal negotiations and seemed content with the default, informal arrangement.

While scientists and firms seemed content, research suggests that such informal relationships and informal transfer of IP rights to firms may have been detrimental to commercializing university-originated inventions (see Kneller 1999, 2003). Because the collaborating firm could cancel an invention's development but still monopolize the right to use the IPs, no other firm could take on the job of commercializing the invention, even if the invention seemed promising. However, the practices of maintaining relationships of trust and instituting informal agreements were ingrained and served as a practical option for engaging in academic entrepreneurship before the introduction of the new rules in the 1990s.

The change brought by introduction of Japanese Bayh-Dole Act and other measures had two characteristics that were drastically different from this previous mechanism: it required that collaborations be formalized through research contracts and licensing agreements, and it introduced intermediaries such as university offices of research and technology-transfer offices to help scientists deal with university-industry interactions.

### **The change: formalizing academic entrepreneurship and introducing the “American Way”**

Starting in the 1990s, Japanese government officials increasingly began to see Japanese technology transfer as suboptimal. This perception was in great part caused by comparing

Japanese academic entrepreneurship with that of the United States. The U.S. model was especially successful for biotechnology, a field in which university startups and successful commercial applications of university-originated inventions had created a whole new industry that boosted the U.S. economy. Looking at the greener pastures of the U.S. biotechnology industry, the Japanese government moved to promote commercialization by implementing new policies.

The Japanese Bayh-Dole Act—the equivalent of US Bayh-Dole act that allows universities and other entities to be patent owners of findings out of nationally funded research—passed in 1999. Another act, the “TLO Act,” passed just before the Japanese Bayh-Dole Act in 1998. This allowed approved technology licensing offices (TLOs) to start up their operation with governmental aid. In accordance with these changes, both public and private universities gradually started to claim the IP rights to inventions that resulted from their faculty members’ research – thus practically cancelling the 1978 MEXT notifications. Similarly, the restriction regarding dual employment of public employees began to relax in 2000 to enable national university scientists to be involved as board members of businesses that were related to technology transfer.

The final step to this repositioning of academic entrepreneurship was the National University Corporation Act in 2004. This act gave national universities individual corporation status and allowed them to freely develop their own strategies regarding university-industry collaboration.

To adapt to the change, universities strengthened their “Office of Research”<sup>7</sup> facilities so that they could deal with contract research and collaborative research with firms, screening and filing patent applications, and marketing university IPs to firms. At the end of 2010, all major Japanese universities had such divisions for university-industry relations, and there were 50 approved TLOs working with affiliated or contracted universities in Japan (*Asahi Shinbun*, 9/18/2010).

The policy emphasis on commercialization has also become extremely visible and clear, even in research funding: applications and reports for grants-in-aid from MEXT or MITI (the equivalents of American NSF and NIH funding) require researchers to report their patenting records. Additionally, application research became increasingly important for securing different kinds of funding, including funds for potential applications of basic research, funding for university startup, and matching funds for collaboration with firms.

By 2010, when I began to conduct the interviews for this research, most of the policy and institutional changes had been in operation for more than five years. At this point, in terms of legal and organizational arrangements, Japan probably had an even more favorable environment for technology transfer than the United States. At present, Japanese universities are equipped with a new, official system that university scientists and firms are supposed to follow. According to this system, collaborations with industry operate as follows: If a professor and a firm want to conduct a research project together, they sign a formal contract laying out the collaborative research plan through the university’s administrators. Next, when findings from the research are deemed patentable (and potentially profitable), the technology transfer office patents the

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<sup>7</sup> These are called by various names, including “university-industry collaboration office,” “division of university corporate relations,” and “management center for IP and innovation.”

invention. The invention will be owned by the university (as the Japanese Bayh-Dole dictates). If the university and the firm successfully negotiated licensing agreements, a part of the royalty will be paid to the inventing professor. Alternatively, if a professor finds his academic research (without any firms' involvement) to be patentable, he should contact the university to patent the invention. After screening, the university applies for the patent, and through the TLO, licenses the invention out to a firm.

By formalizing the commercialization processes and involving the university in the process, the changes created a pathway for university scientists to follow without being reliant on firms and also eliminated ambiguity in relation to responsibility and ownership. The new scheme allows university scientists to negotiate the terms of collaboration with the help of university Office of Research and the technology-transfer office. In compliance with the Japanese Bayh-Dole Act and other regulations, any inventions arising out of such collaboration should be university-owned, and scientists' fair share of the royalties should be reimbursed upon licensing.

Although in theory, scientists should have welcomed such changes, the university scientists I interviewed did not replace the previously used practices with the new procedures. Japanese university scientists by and large accepted the new, formal methods of academic entrepreneurship; none ever voiced overt objections to the changes. However, instead of simply transitioning to the new procedures, they negotiated and created a set of new practices that decouple from or loosely couple with the new formal rules.

The pattern of loose coupling was strongly affected by the old practices of informal collaborations with firms. University scientists tried to ignore the formal rules and keep the old,

informal collaborations if that was at all possible, and thus completely decoupled practices from rules in some cases. When they couldn't ignore the rules, either because of the firm's and university's monitoring or because they felt it was illegitimate to do so, they found ways to loosely couple old practices and new regulations by partially following the formal rules while reappropriating them to replicate the old practices to some extent.

## **Responses and Reappropriation**

### *Retaining the old practices*

Although the university scientists I interviewed did start to use the new scheme, most university scientists who had been involved in patenting, working with firms, or establishing firms before the change expressed some reservations about the new scheme and tried to keep using the old practices. Among the interviewees, 17 out of 40 scientists explicitly said that they still enacted the old practices to some degree (for example, working with firms informally and being paid by donations, or assigning IP rights to the collaborating firm), and anecdotal evidence suggests that this is true for most universities (also see Kneller 2003 for the use of donations). Thus, for example, a 2012 University of Tokyo report suggests that there were 1,547 contracted collaborations with firms in 2011, whereas there were 12,038 research donations. The total funding received by donation was 1.8 times as much as that received by contracted research. Although there is no way to know how many of these donations were "true" donations that did

come with strings attached, the numbers and my interview data suggest that the old practices of using donations for university-industry interactions were ubiquitous and pervasive.

When scientists had already established a relationship to commercialize their scientific findings through informal, gift-exchange like practices, they only resorted to the new means of commercialization when they thought compliance was an issue. If there was little monitoring or if they found ways to “work around” the rules, they did so. A prominent professor in a private medical school explained how he sticks to the old practice: At any given time, his lab had quite a few scientists from multiple firms coming to learn and develop applications. The firms would then give the lab Syougaku-kifu donations. When I asked how they managed patentable inventions, he replied,

Patents are costly. So we use firms, ask them, “Do you mind securing this patent?” and they’d pay all for patenting, on my name [as inventor]. From the firm’s perspective, if it sells, it’s a “gentleman’s agreement,” so they’ll give me money. Recently, there seems to be a university system; if they think it’ll fly, they’ll OK and patent it using the university’s budget. But it is extremely minor.

In this case, the researcher said that he used firms for donations and to obtain patents and clearly stated that he tried not to use the new scheme. As he is extremely well established, and the private medical school where he works did not tightly monitor faculty’s entrepreneurial activities, he had not had to succumb to the new rules.

Public universities, on the other hand, tend to have more surveillance, so neglecting the formal rules had become increasingly difficult by the time of the interviews (2010-2012.) Still, university scientists could try to keep using the old practices. A professor at one of the best national universities stated that he prefers the old practices but felt pressured to use the new procedures:

[Interviewer: Are the collaborations with Syougaku-kifu or collaborative research contracts?

Most of them are contracted collaborative research. Honestly speaking, it's better to have Syougaku-kifu for us, because we don't have to use them up. [...] Contracted collaborative research has an agenda and plans, and the contract, all these specifications, and you need to report on it afterwards. Syougaku-kifu is, like, "fellowship support for advancing agricultural research," that'd be it. [...] but now it's becoming impossible, as we are pushed to having to have contracts if there is a clear research objective.

As the interviewee states, he would much rather have informal, old-scheme arrangements; he especially valued the fact that under the old scheme, the lab would not be bound to specific plans and budgets. Later on in the interview, he said that he would release IPs to the firm for about \$20,000 of donation money. However, he also said that he found himself under a great deal of pressure from the university to go for the new, formalized route to commercialization and actually collaborates using the new procedures most of the time.

Over time, even when the scientists tried to keep using old practices, it became harder to completely neglect the new, formal procedure. To “solve” this tension, scientists then negotiated a set of loosely coupled practices by demonstrating compliance and using the new procedures in a partial manner or by negotiating within the new rules for specific terms of collaboration.

### *Reappropriating rules*

One way scientists demonstrated tight coupling while keeping the old practices to some degree was to follow the formal procedures only when it became clear that the collaborations would yield potentially valuable inventions, so that in those cases, the university would be officially involved in the research and IP allocations. As an associate professor in a national university stated:

For a feasibility study, if it is collaborative research, for the first six months we'd run with only a nondisclosure agreement with donations, with minimum paperwork. And we'll do collaborative research if something was to be found.

In an effort to maintain some flexibility of research timing, topic, and budget, this professor began his collaborations using the old practices – receiving donations and starting research with minimal paperwork. Only when the collaboration took off would he and the firm contact the Office of Research and construct formal contracts. In this way, he was able to work with firms in a free-flowing manner, receive donations, and avoid the delays caused by negotiation and paperwork between the scientist, firm, and Office of Research. When they thought the



collaboration would be substantial and yield valuable IPs, they then negotiated and went through the new, formal route of having contracts for the sake of legality. Even after entering into the contract, however, the scientist would negotiate *for the firm* – so that the firm would get as many IP rights as possible. Continuing the conversation, the scientist explained how he tried to allocate IP rights:

So in this kind of research, the patents around it [the finding to be patented] are already acquired by firms. So [university] having one patent out of a whole portfolio [of patents] wouldn't make sense. Having said that, in some cases, I like to give back to the university. So my theory is that we don't have to treat 10 patents all the same. Some I arrange to be 1:1 patent rights to the university, some 80% to the university. But the university has only one standard form, so their response used to be so slow. Now they have meetings twice a month though...I hated the delay and just patented in the old way [giving the rights to the firm] – but they [university] are getting cleverer these days.

In the United States, IPs arising out of firm collaborations are typically owned by the university only, with the firm having first-refusal right (the right to exclusively license the IP). In Japan, by contrast, a firm can negotiate to become a co-assignee of the patent (and thus acquire the right to exercise it free of charge). As the excerpt shows, scientists may support this arrangement and even work for the firm to get as much leverage as possible out of the collaborations. The professor above is a good example.

The professor was accustomed to giving out patents and receiving donations. Now, using the new scheme, he tries his best to win IP rights for the collaborative firm because, as he argues, it

does not make sense for the university to own a part of the set of IPs. It does not make sense, however, only if one takes the perspective of the firm. From the university's perspective, it is entirely legitimate to own rights to IP that arose from university professors' research.

Scientists often negotiate for the firm when using the new procedures, exhibiting a willingness to forego the potential benefits of a contract that is favorable for the university. An assistant professor who only uses the new procedures told me that when the firm and university have a contract, he strategically maneuvers for the firm so that it will have as much leverage for IP rights as possible:

I think the "compensation for non-use" clause doesn't make sense, so I try to get that out of the contract. [.....] ...in [Firm name]'s case, the Office of Research compromised. Because when it [contract negotiation] takes so long, it becomes a game of who caves in first. The most important part is the basic collaborative research contract. The firm says we are ready, when shall we start, and if that contract is delayed, the budget won't kick in, so the scientists are in trouble. So we can push the Office: "What are you doing to us?" Then, since the university is weak in negotiations, they'd allow us to have the contract on budget before detailing out everything else -- they'd want the money to come through within the fiscal year so that the Office of Research is funded as well....and then they'd have to compromise later, because things are moving. And once we create the precedent, the world revolves around precedents (laugh).

Although this assistant professor did abide by the new rules, he negotiated within the new formal rules so that the resulting form of collaboration was actually close to the way the old practices

worked. The university Office of Research usually tries to enforce a “compensation of non-use” clause for IPs arising from collaborative projects. This clause asks for the royalties to be paid to the university as a co-assignee of the invention that does not exercise its right to either use the patent or license it. Japanese universities typically ask for this clause. But firms that are accustomed to sole ownership of the patent prefer to avoid paying a fee. The assistant professor, then, strategized to meet this firm’s demands. He managed to drop the compensation clause by beginning the collaboration without developing the details of IP right allocations so that the university would later be forced to compromise.

What is striking in these two excerpts is how the scientists talk on behalf of firms. Because Japanese scientists wanted to maintain their informal, trust-based, dyadic relationships with firms, they did not particularly want what would seem to be clearly advantageous contracts for themselves; they even treated the Office of Research as invading their collaborations with firms. Therefore, the scientists wanted to negotiate some kind of arrangement that would be flexible and also enable them to “do favors” for firms.

In both cases, scientists decoupled the rules from actual practices without completely breaching the new rules. In the first case, by using the new rules in partial manner, the scientist kept the flexibility of informal collaboration until the collaboration was on track. Even after the collaboration was on track, he only wanted the university to have IP rights in some cases. In the second case, the scientist completely abided by the rules but negotiated within their boundaries so that the firm would have as many of the IP rights as possible – thus creating a form of collaboration that is surprisingly similar to the old practice.

A final example shows an extreme case of a scientist misrepresenting the IP so that he could still give IPs to firms while complying with the new rules:

Interviewer: If there are patentable findings, how do you patent them? Who is the applicant, and who is the inventor?

Interviewee: Recently, all firms (as applicant)... we go through them [TLO], but then, we'd write the form in such a way that university won't take interest [in securing IPs], and then they'd reply to us saying, "Do whatever you want." A guy from the IP division would come, and we'd suggest that it wouldn't have much commercial potential, and then they'd reject it. They are inclined to say "no" to start with, because they filed too many patents for a while and they're incurring cost for it, so they're throwing them out.

This scientist's approach to the new procedures bordered on deception: he described going through university's patent appraisal but writing it up so that the findings looked unappealing. Once the university refused to patent the invention, he was free to do whatever he wanted with the invention – in other words, to give it to the firm he was working with. This might sound illegal, but when I asked him if it was okay, he replied casually, "Well, there is no punitive clause, and they [university] don't have money to patent, so?"

Thus, even when scientists seem to follow the formal rules perfectly, they can, and do, loosely couple actual practices with formal rules by following the rules in a partial manner or negotiating within them. All three of the scientists quoted seemingly abided by the new rules but also undermined them by working around them and negotiating within them. The first scientist

followed the rules but created the formal contract later than it was supposed to be created. The second scientist followed the formal requirement perfectly but acted against the interests of the university administration. The third scientist went through all the formal procedures properly but misrepresented the invention.

In all three cases, as in other interviews, the resulting form of collaboration was similar to the way the university-firm collaboration worked before the introduction of the U.S.-style regulations. Thus, even when scientists did not completely ignore the new rules, there seemed to be a strong “pull” from the experience of old practices. The scientists tried to work informally as much as possible. They identified with and attended to the needs of collaborating firms rather than the university Office of Research. Responding to the firm’s request to secure exclusive use of the IPs, the scientists negotiated with, and in the last case, even deceived the Office of Research to let the firms have as many IP rights as possible.

The actions of these university scientists may seem puzzling. The intention behind the policy change was to make academic entrepreneurship more straightforward and attractive to academic scientists by eliminating informal, unclear conditions that often work for firms, not scientists. Additionally, the changes were meant to relieve scientists of responsibility for negotiating the specifics of technology transfer in each case. As discussed above, research indicates that the old practices are economically disadvantageous to Japanese university scientists. However, the interviews show that the old practices worked as a template for what collaboration should look like.

The informal relationship the scientist and firm created before the changes were necessarily based on trust – there were few binding contracts, and donations played a large role. The old practices thus cultivated relationships between scientists and firms that emphasized covert agreements to exchange favors. When the new rules were introduced, it breached this gift-exchange style of reciprocity and relationship. Both firms and scientists had to work through a new set of practices under the new formal collaborative scheme. Scientists consistently took firm’s side and negotiated with the Office of Research and technology-transfer office to win the firm more flexibility and IP rights with less financial commitment. During the interviews, the scientists did not say that they negotiated for the firms in hope of increased donations. Instead, they expressed dissatisfaction and frustration that they were no longer able to offer firms what they used to be able to offer, and so had to find new ways to organize the reciprocity relationship. To maintain social relations with the firms they work with, the scientists ignored the new rules when they could. But as the legitimacy of the new rules increased and monitoring continued, they had to reinvent a similar arrangement under new conditions. Their solution was to reappropriate and loosely couple practices and rules– taking new routes to reach to the same (or, at least, a very similar) destination.

## **Discussion**

The introduction of the new, U.S.-inspired structure of academic entrepreneurship to Japan did not proceed as expected. Japanese biotechnology scientists were poised to gain from the change

economically, but in practice, they did not simply adopt the new regulations. Instead, they created a set of loosely coupled practices that resembled previous, informal collaboration practices. Sometimes, the university scientists I interviewed just neglected the new rules, but more often, they crafted a set of practices that made the collaboration resemble the previous relationships and practices.

This helps us understand both global scientific practice and how loose coupling works more generally. The global influence of the U.S. model of academic entrepreneurship on legal reform may lead us to believe that a single model of academic entrepreneurship has been institutionalized – after all, equivalents of the Bayh-Dole Act are being adopted by country after country. But when we look at how scientists are responding to this legislation, the variation from the U.S. model of academic entrepreneurship is striking. The Japanese case reminds us that the institutionalization of academic entrepreneurship in the United States is a historically specific construct that has depended on the interactive responses of scientists, policymakers, industry leaders, and university administrators (see also Berman 2008; 2012, Colyvas 2007, Colyvas and Powell 2006, 2007; Etzcowiz 1983, 1989, 1998; Powell and Colyvas 2008).

In this empirical sense, my findings suggest that in countries where collaborations between firms and scientists were managed informally, scientists may try to maintain personal, gift-exchange-like relationships with collaborating firms. Their efforts may create different practices of academic entrepreneurship despite legislation that imitates that of the United States. In some European countries – such as Italy and France – firms commonly own or co-own IPs with universities despite legislation similar to the Bayh-Dole Act (Geuna and Rossi 2011). Such

instances may seem like idiosyncratic deviations from the U.S. model, but taken together, they actually form a pattern. The experience of these countries demonstrates how people negotiate loose coupling between formal rules and actual practices: in the Japanese case, previous gift-exchange relationships “pull” actors to making the new arrangement resemble the previous default.

Studies of academic entrepreneurship in late-adopter countries tend to focus on how scientists come to practice academic entrepreneurship in the new, formalized manner – for example, how the number of university-owned patents or formal collaborative contracts increased (but see Abreu and Grinevich 2010; Lam 2010; Perkman et al.).<sup>8</sup> Those measures are important. But by understanding how the previous practices continue to “live” in the loosely coupled practices that local actors create under the new rules, researchers can avoid the mistaken conclusion that academic entrepreneurship is quickly transitioning to be just like it is in the United States everywhere (see also Kneller 2003). Instead, we can start tracing how the institutionalization of academic entrepreneurship is happening globally—how local variation is sustained at the same time that the U.S. model is diffusing.

While these questions are tied to the specific history of commercialization and entrepreneurship, this research also informs more general debates. Studying informality – and its effect on how new legislation is practiced – opens up other questions. Informal economies do not entail the artificial separations between the social and the economic that “market logic” presupposes (Krippner 2001; Zelizer 1989, 1994). Collaborations between Japanese university scientists and

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<sup>8</sup> In fact, as Murray (2002) notes, even research on the United States tends to focus on the formal interactions between universities and industries—thus missing other types of academic engagement such as consulting.



firms were at the same time, and explicitly, about relationship-building, scientific endeavor, IP creation, and monetary transaction. Such gift-exchange-based relationships are hard to break, because reciprocating favors is a focal point of sustaining these relationships (Lainer-Vos 2012; Mauss 1954). The relationships that these practices are embedded in thus tend to be extremely resilient.

Tracing these relationships allows us to see that often, what is described in the organizational literature as “resistance to change” (Labianca et al. 2000; Zucker 1977).) involves a shift from informal, personalistic relations to more formal, bureaucratic ones. These cases studies also show that the social relations that contextualized the previous practices shaped the way that actors figured out new practices. Thus, for example, in Gouldner’s *Patterns of Industrial Bureaucracy* (1954), the introduction of new, bureaucratic rules was a shift from an informal, trust-based relationship between the previous manager and the workers to one of bureaucratic, rule-based control. The workers felt that they were deprived of activities to which they were rightfully entitled: taking absence for personal reason, using some properties of the mine for personal use, and in general using their own discretion in determining how to work. The final form of loose coupling was the form that was “pulled” to the old practices of trusting the workers: the new manager and workers finally settled for enforcing the rules only when both parties deemed them necessary and sensible (see also Hallett and Ventresca 2006ab).

Research has shown that local actors negotiate loose coupling because of preexisting beliefs and practices, previous local orders and authority, and local forms of meaning making (Coburn 2004; Hallett 2012; Hallett and Ventresca 2006ab ). As I show here, the properties of the relationships

within which the old practices were embedded are an important factor in these processes of sense making and negotiation. Indeed, in the case I describe, sense making relied on relationships: scientists took on the interests of the firm rather than those of the university. Finally, all practices include tacit agreements and relationships. Characteristics of the kinds of relationships in which actors are embedded –such as the degree of informality of previous practices, or the degree to which the relationships became multiplex and reciprocal – influence how local actors act when new formal structure is adopted.

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## **Chapter 2**

### **Global Policies and Transnational Repertoires of Action: Rethinking Local Adoption and Decoupling at the Periphery**

## **Introduction**

This paper theorizes the effect of the transnational flow of ideas, people, and resources on the ways that global policies are practiced in places other than their country of origin. In general, researchers assume that as policies diffuse to different environments, local actors must struggle to enact practices that meet the demands of new rules, standards, and environments. This explanation for the discrepancy between the formal structures and actual practices has thus been essential for multiple scholarly traditions in organization theory. New institutionalism developed partly to explain the discrepancy between what is adopted and what is practiced—and thus identified the cause of such decoupling. Organizations adopt “institutionalized products, services, techniques, policies, and programs” (Meyer and Rowan 1977: 41) not primarily because it will make the organization more efficient but because doing so increases the organization’s legitimacy—and therefore the chances of survival in an uncertain environment (DiMaggio and Powell 1983; Dobbin 1994; Kelly and Dobbin 1998; Meyer and Rowan 1977).

In this article, I theorize the relationships between global structures and local actors whose horizons transcend national boundaries, and I show how actors’ transnational repertoires of action shape the way they practice global structure. I study the local consequence of a specific type of science and technology policy that is diffusing throughout the world: policy that promotes academic entrepreneurship. Literature on decoupling and local innovation suggests that when rules that do not fit the local exigency are implemented, actors negotiate to neglect these rules, abide by them only ceremonially, or find a compromise between local practices and the new rules. Studies have shown that the form of decoupling depends on local contingencies such

as power dynamics, meaning systems, and the actors' initiative initiative (Coburn 2004; Edelman et al. 1999; Goodrick and Salancik 1996), as well as on the existing practices. I argue that, in the case of local responses to global policies, actors' cosmopolitan orientations and repertoires also influence how they negotiate local adaptations.

Specifically, I trace how university bioscientists in Japan responded to the introduction of a U.S.-style structure of academic entrepreneurship. In the late 1990s, Japan introduced academic entrepreneurship policies that closely imitate ones implemented in the United States in the 1980s. Before that time, most collaboration between academia and industry in Japan was handled informally: firms gave "donations" to a scientist's lab, and scientists worked with them and in some cases passed on the intellectual property that resulted from the informal collaboration. In this rather laissez-faire environment, there was no structural support for the commercialization of faculty inventions. With the introduction of U.S.-style policies, the Japanese government aimed to create a more structured, formalized environment in which commercialization would be understood as a regular part of what academics and universities do. I draw on in-depth interviews with leading Japanese university bioscientists to show how they created a set of decoupled practices that enabled them to sometimes work with industry as they had been used to doing before this policy shift.

The term "repertoires of action" conceptualizes the idea that people embody not only cognitive schema or "purposes" toward which they direct their actions, but also an array of practices that they use to achieve these goals. Thus, repertoire theory directs researchers' attention to the experience-based acquisition of practices and to actors' ability to select different practices .

(Mizrachi et al. 2007; Swidler 1986). Drawing on this insight, I show that the form of decoupling that occurred in Japanese bioscience was not a simple compromise between local practices and new rules, but rather a change in the bioscientists' repertoires of entrepreneurial action. Japanese scientists had been exposed to the U.S. commercialization environment well before its formal adaptation, and that experience shaped the ways they navigated the Japanese commercial world in two different ways. First, some Japanese scientists who were familiar with the U.S. structure of academic entrepreneurship were already more contractual and so swiftly adopted the new rules. In these cases, policy adoption did not change many of the scientists' practices, since they already were working in ways that aligned with the new policy. But for most scientists, the picture was more complex. Some scientists with this same level of familiarity with the U.S. system enjoyed having two systems of commercialization available to them: the informal Japanese method and the formal American system. Scientists with such transnational repertoires of action did not see the point of completely switching from informal to formal methods of academic entrepreneurship within the Japanese context. Rather, they purposively selected resources, regulations, and opportunities across national boundaries. In some situations, they chose to work informally with Japanese firms; in other situations, they chose to formally collaborate with Japanese firms through their university's Office of Research, and in still other situations, they chose to bypass the Japanese environment altogether and establish their startups in the United States.

Drawing on insights from new institutionalism and the literature on global policy, I thus theorize that the "decoupling" of global policy adoption is modulated by actors' trans-local experiences

and transnational repertoires of action. I show that in cases of global policy diffusion, the local actors may be “trans-local” and thus able to use resources and networks that extend beyond national boundaries. Such trans-local actors may negotiate new practices based not only on the local system, but also on their knowledge and expertise in transnational practices that they have already incorporated into their repertoire of action.

### **World Society, Global Diffusion of Policies, and Japan**

Japan is well known for adapting practices and artifacts from other countries and “tuning” them as it sees fit. Japanese policies are no exception. Since the time of the Meiji Restoration, which drove the country down the path of modernity in the nineteenth century, Japan has been the quintessential example of a country that adopts policies from core countries. Of course, structural imitations on a national level are all too common. That the periphery copies the more central, stronger, and richer core is a central idea that undergirds Meyer et al.’s (1997) theory of world diffusion. Indeed, new institutionalists explain similarities in nation-states’ structures and ideologies as the effect of an isomorphism in which less-powerful countries adopt the culturally legitimate structures of more-powerful countries in their pursuit of legitimacy.

Science and technology policy regarding university inventions and commercialization seems to serve as yet another example of such adoption. Since the 1960s, universities in the United States have been transformed into what Berman (2012) calls an “economic engine” through which knowledge production has direct impact on economic prosperity. This transformation began with

the birth of biotechnology, whose successful applications catalyzed changes in policies and university regulations (see Etzcowitz, 1998 etc; Mowery 2004; Zucker et al. 2002). In the 1970s, the current environment for commercializing university-produced inventions had begun to take present shape (for earlier stages, see Berman 2012; Owen-Smith and Powell 2003; Sampat and Nelson 2002). By the 1980s, various forms of university-firm collaboration became common in the United States, and formal structures detailing the procedures and rights of the university and its scientists were developed.

In a nutshell, the U.S. formal mechanism of academic entrepreneurship works as follows: if faculty members wish to secure intellectual property (IP) rights to their inventions, they are required to file a report with the university's technology transfer office, and if the office regards the invention as valuable, the university will file a patent application. The university would then hold the IP rights, in accordance with the *Bayh-Dole Act*, passed in 1980, which allows universities to control IPs arising from federally funded research and stipulates that a part of licensing revenue will be allocated to the scientist and her lab based on the university's regulations. According to this organizational and legal schema, the university's Office of Research manages collaborations between university scientists and firms as well as contracts between the university and firms (Berman 2008).

This U.S.-originated structure of academic entrepreneurship has gained legitimacy and spread worldwide. According to the Association of University Technology Managers, many European countries, as well as Brazil, China, South Korea, and Japan, have now passed a law equivalent to the *Bayh-Dole Act*. The Japanese government also implemented a series of changes in science

and technology policies between 1995 and 2005, explicitly modeling itself after the U.S. environment for academic entrepreneurship. Of course, Japanese scholars did have interactions with industry before this period, and professors had commercialized their inventions even before the implementation of the U.S.-style academic entrepreneurship. But universities did not have formal mechanisms to support these activities, partly because most research universities were (and still are) nationally owned, and thus the research had historically been considered public property.

This lack of formal mechanisms afforded a space for individual university scientists and Japanese firms to create informal relationships and practices. Called “Syougaku-kifu,” literally meaning “scholarship support for study,” this system consisted of donations to national universities by private firms or individuals for the purpose of supporting academic research. The Syougaku-kifu scheme started as early as 1964 (Ministry of Education 1964) and allowed firms relatively informal access to university scientists. Because Syougaku-kifu was defined as a donation, donors could not legally specify the purpose of its use. Crucially, however, they could specify which professor’s lab the donation would be forwarded to. The flexibility of donations led firms and scientists to use them for informally agreed-upon purposes, such as collaborative research or payment for the IPs handed to the collaboration firm. The government did not regulate inventions arising from faculty members’ own research (including donation-funded research) in the same way that it regulated commissioned research and research funded by grants-in-aid (the equivalent of NSF funding). By law, inventions arising out of formal collaborative research or research funded by grants-in-aid belonged to the nation (until the



*Japanese Bayh-Dole Act*), but a 1978 notification from the Ministry of Education dictated that scientists could do as they saw fit with their rights over all other inventions (Ministry of Education 1978). This notification enabled university scientists to hand their IPs over to collaborating firms that used the Syougaku-kifu system.

By using donation scheme, university scientists could routinely give away the IP rights of any inventions to their collaborating firms and expect to continue working with the same firm and receive even larger donations. Since scientists normally did not wish to patent their inventions out of pocket and there were no university technology-transfer offices that would consider patenting, the unofficial, informal route was an easily accessible way to secure patents (see also Kneller 2003). As a result, informal collaborative projects were far more ubiquitous and were generally seen as legitimate. Donations usually ranged between \$5,000 and \$30,000 and were widely used as a method of payment for collaborative research. The practices of maintaining relationships of trust and instituting informal agreements were ingrained and served as a practical option for engaging in academic entrepreneurship. The university scientist and the firm usually exchanged a memorandum regarding a nondisclosure agreement, but many conditions of collaborative research were kept open. The relationship between scientists and firms was thus characterized by noncontractual reciprocity that resembled a gift exchange (Branscomb et al. 1999 ; Kneller 2003). Scientists would receive donations from firms, and in exchange, they would often “give” the firm IP rights, trusting that the firm would give them appropriate returns despite the lack of legal obligations to do so. This informal practice flourished as collaborations

between university scientists and firms increased beginning in the 1980s (Zucker and Darby 2001).

The legal and institutional changes that attempted to replace the donation system began in the mid-1990s for reasons largely exogenous to the needs of the field. The Japanese government decided that Japanese academia was falling short of its potential in commercializing university-produced knowledge, especially compared with the success of U.S. biotechnology. A series of policy initiatives followed. The Science and Technology Basic Act was established in 1995 to enable more hands-on promotion of science and technology by the government, and by the end of 2005, numerous policy changes driven by governmental initiatives had lifted restrictions on commercialization. The “TLO Act,” passed in 1998, provided government aid through 2008 for approved universities to open technology-licensing offices (TLOs). By the end of 2010, all of Japan’s universities have instituted such divisions for university-industry relations, and about fifty approved TLOs are currently working with affiliated or contracted universities in Japan (Asahi Shinbun, 9/18/2010). In 1999, Japan passed the *Japanese Bayh-Dole Act*, the equivalent of the U.S. *Bayh-Dole Act*, which allows universities to be patent owners of findings resulting from nationally funded research. This was followed in 2001 by an ambitious intervention to develop venture companies originating from university-produced scientific knowledge. Beginning in 2000, a restriction regarding dual employment of public employees was gradually relaxed to enable national university scientists to be involved as board members of “technology-transfer- related” businesses—in other words, businesses that use the professor’s invention.

Finally, in 2004, *The National University Corporation Act* allowed national universities to freely develop their own strategies regarding university-industry collaboration.

These changes require, at least formally, that scientists go through the new and formal routes to collaborate with industries. Officially, a university scientist and a firm need to sign a collaboration contract before the start of their research, and inventions from either industry collaborations or the scientists' own research need to go through the university TLO to get patented. All inventions are to be owned by the university, per the Japanese Bayh-Dole Act and the university regulations that stipulate universities' rights over employee's inventions. Thus, governmental initiatives urged university scientists to abandon informal practices of working with industry and instead adopt a more formal, university-involved approach to academic entrepreneurship.

Even elementary research, however, reveals that local practices after the change were far from the formalized rules dictated. Donations from firms to university scientists did not decrease (Cite MITI 2006), and initial governmental reports suggest that university ownership of faculty inventions has not been institutionalized (Kneller 2003). Instead, co-ownership of patents by universities and firms increased, and firms still sometimes singlehandedly own the IP rights that arise out of collaborative research, although this is now a legally problematic arrangement. Just as institutionalists would predict, practices have decoupled from the formal rules. This decoupling raises a number of questions: *how* the adoption of a global policy was decoupled in action, and what are the mechanisms through which a local adaptation of global diffusion occurs, and what roles the actors play in it?

### *Institutionalism's Turn to Micro-level Foundations*

Recent studies in new institutionalism show how decoupling is actually managed. Decoupling is not an easy accomplishment: once an organization (or a nation-state, in cases of national policy) implements a certain structure, the external and internal pressures to change the internal structure increase (Dobbin 1988; Edelman 1999; Sauder and Espeland 2009). Meyer and Rowan's (1977) original formulation emphasized the "mythical" nature of formal structure and suggested that local actors only ceremonially embrace the myth without changing their work practices in significant ways. Increasingly, however, studies have shown that rules and practices are interconnected and responsive to each other, and these findings have required researchers to reconsider the assumption that formal structures are merely ceremonially adopted. When rules change, practices also tend to change, albeit partially—as a result, scholars have begun to ask how this loose coupling is managed and what factors affect the way decoupling is accomplished in practice (Dobbin et al. 2011; Hallet 2012; Hallet and Ventresca 2006ab).

New institutionalism attempts to integrate macro-level environmental influences on organizations and micro-level cultural-interactional dynamics inside them. Instead of conceptualizing organizations as rational actors, new institutionalists treat the need for efficiency and the need for legitimacy separately. Organizations adapt "institutionalized products, services, techniques, policies, and programs" (Meyer and Rowan 1977: 41) not because these will make the organization more efficient but because doing so increases the organization's legitimacy, and therefore its chance of survival in an uncertain environment (Meyer and Rowan 1977; DiMaggio

and Powell 1983; Kelly and Dobbin 1998). Since work requirements are often inconsistent with legitimated rules, however, organizations embrace the formal rules only partially, decoupling formal rules and technical activity in practice. Decoupling thus is the key mechanism by which an organization can fulfill two often contradictory goals: legitimacy and efficiency.

To adequately understand how the adoption of structures affects organizations, an institutional theory needs strong micro-foundations. As Scott (1987, 2008) argues, institutionalists tend to either treat actors as either cultural dopes who merely carry out cultural schemes or depict actors as free-floating strategic agents. Both depictions, he notes, are empirically untrue. To explain the variations in how organizations incorporate the formal rules they are subject to, institutionalists need to consider the indigenous factors that shape the ways that organizational participants negotiate decoupling (Dobbin et al. 2011; Edelman 1999; Rao et al. 2003), as well as the ways they negotiate environmental pressures. Organizational inhabitants must be understood in their complexity: they are agentic in that they use what Emirbayer and Mische (1998) call “projective capacity” to strategize and choose actions in the new environment, and they are also strongly affected by cultural-cognitive framework they live in, their resources, and their interactions within and beyond the organization (see Hallett and Ventresca 2006 ab).

Recent calls for “inhabiting institutions” aim to reintegrate agency into new institutionalism by forefronting institutions’ interactional foundations (Berman 2012; Binder 2007; Hallett and Ventresca 2006ab; Scully and Creed 1997). Building on organizational researchers’ longstanding interest in “bringing back agency” (see Barley 1986; Barley and Tolbert 1997), this line of work urges researchers to study the ways that actors’ responses to institutional and environmental

forces shape institutional practices and structures (Basu et al. 1999; Espeland 1998; Hallett 2010; Hallett and Ventresca 2006; Owen-Smith 2010).

Drawing on the tradition of interactionist ethnography of work (Blumer 1969; Gouldner 1954; Glaser and Strauss 1965), this approach reorients researcher's attention to social interaction within the organization and its generative role in meaning-making and in sustaining or changing organizational structure and practice (Hallett and Ventresca 2006ab). Members of an organization have multiple logics available to them in every interaction and thus are able to invent creative practices under new rules. They do not only act according to taken-for-granted routines, but may also reshape situations by making decisions about their work in everyday work (Binder, 2007; also see Emirbayer and Mische, 1998).

This study resonates with this recent initiative in institutionalism, and further advances the inhabited institutions perspective by analyzing a case that involves national policy. The inhabited institutions perspective has largely focused on observations of a few organizations and the coupling between those organizations' practices and their institutionalized rules. My study delineates how, in a case of international policy diffusion, local actors in the adoptee country negotiate loose coupling of rules and practices. But first, to understand the impact of the globalizing world on decoupling, it is necessary to outline current debates about global policy and its diffusion.

*Global Professions, Cosmopolitan Actors, and Diffusion of Policy from the Core to the Periphery*

The explanatory scope of the isomorphic process that Meyer and Rowan first described was in no way limited to organizations within one society. In a series of papers, Meyer and his colleagues (1977, 1978, 1999, 2005) showed that nation-states imitate the structures of core countries, despite vast internal differences. World society theory stresses that the global networks of nation-states, quasi- and nongovernmental organizations, professional organizations, and other ties among individuals in the world create isomorphism on a global level. Policies and ideas from core countries –culturally and economically –are quickly imitated by others, despite significant internal differences among nation states. This imitation takes place in multiple fields (Meyer et al. 1999), including human rights (Hafner-Burton and Tsutsui 2005; Beck et al. 2012), economic policy (Beckfield 2008), educational systems (Anderson-Levitt 2003), and other policies (Simmons and Elkins 2004). From abstract ideas and codified laws to sushi and popular music, practically every aspect of society may be imitated, despite local differences.

Due to its global nature, policy adoption is even more complex than the adoption of organizational structures. In the diffusion of organizational structure, the adoption is usually a managerial decision. Nation-states, on the other hand, consist of multiple layers of actors with different projects and orientations (Friedland and Alford 1991). Diffusion of structures, ideas, and practices work simultaneously in different ways with different groups, which leads to even more “internal inconsistencies and contradictions” (Meyer et al. p.144, 1997) than we see in organizational decoupling.

Thus, for example, in her study of the diffusion of U.S.-originated economic policy, Fourcade (2006) shows that returnee economists—foreign students who hold PhDs from top U.S. universities—function as agents of diffusion and legitimacy for U.S. economics and the policies that arise from it. This in turn helps further legitimize the United States’s neoliberal economics and economic policies. Fourcade describes returnee economists as agents for the straightforward imitation of U.S. policy; however, the diffusion of a global structure can also significantly change the diffusing structure. For example, Chorev (2012) examined local reinterpretations of a policy that prohibited the manufacture of AIDS generic drugs in developing countries. Chorev showed that innovative interpretation of this policy among developing countries created a different “legitimate” way of adopting the policy than its original format. Local government officials then learned from such innovations in other countries and further reinterpreted the meaning and rules of pharmaceutical IP rights. As a result of such constant negotiation, the global norm shifted from protecting the patent benefits of pharmaceutical companies to providing affordable AIDS drugs to patients in underdeveloped countries. Thus, Chorev shows that local government agents were knowledgeable actors who were capable of not only adjusting adopted laws to meet local contingencies, but also learning from other countries’ experiences and negotiating a new working order.

These studies suggest two things. First, adopted ideas and rules are not necessarily completely foreign to local actors before their adoption. Second, local actors—who still tend to be conceptualized as enmeshed in their local ways—can reshape new rules and ideas by creatively construct interpretations and practices and by observing how the diffusing rules are practiced



globally. I build upon such findings to advance the study of global diffusion in two ways. First, while these studies focus on how policy is enacted, my research focuses on what happens after the policy has been enacted; I show how local, individual-level actors practice the rules and create further local decoupling at the micro-level. Second, I clarify the role of professional organizations in global policy adoption: I show that professional networks provide individuals actors with transnational knowledge, resources, and practices that enable them to respond creatively to new policy adopted from core nations.

## **Data and Methods**

The study is based on archival research and forty-seven in-depth interviews. I interviewed forty prominent Japanese university bioscientists, five university administrators involved in university-firm collaboration or technology licensing, and two firm scientists who had worked with university scientists and policy makers. Some of the scientists I interviewed also held official administrative positions, for example as a board member of the Council of Science and Technology Policy, in which case I also asked them about their administrative work. I used archival materials to understand the historical background and meaning of the new policies on commercialization. These archival materials included the official policy notice and other documents from the Ministry of Education, Culture, Sports, and Science & Technology (referred to as MEXT); the Ministry of Economy, Trade, and Industry (MITI); the Ministry of Health, Labor, and Welfare (MHLW); and their related semigovernmental organizations (Japan Science and Technology Agency, New Energy and Industrial Technology Development Organization,

and Pharmaceuticals and Medical Devices Agency, Japan). These semigovernmental organizations implement government policies by administering grants, regulations, initiatives, and other policy-related issues.

Most of the data used for the analysis comes from interviews conducted between 2010 and 2012. I selected university scientists who are highly successful and influential. Commercialization policies target these high-profile scientists, because they are the ones who can potentially create the Japanese versions of Genentech or Chiron—biotechnology startups involving academic scientists that became extremely successful; commercialization is most successful when “star scientists” from academia are involved in the process (Zucker et al. 2002). Moreover, studies show that actors and institutions with strong reputations influence others to accept new practices and institutional logics (Stuart and Ding 2009; Owen-Smith 2011). Thus, I chose scientists who appeared on the Institute for Scientific Information’s (ISI’s) list of highly cited researchers, as well as other influential scientists who worked at one of *Times Higher Education*’s two hundred World Top Universities between 1990 and 2010 and are engaged in commercialization activities. Their level of commercial involvement varied from having a copublication with a firm (signaling that they interact with firms) to having their own startups. Additionally, I interviewed policy makers, administrators of universities’ offices of research, university technology-transfer office personnel, and firm scientists. To maintain confidentiality, this article only mentions interviewees’ positions and general areas of research.

I implemented an ethnographic interview method (see Spradley 1979; Weiss 1994) designed to generate understanding of participants’ perspectives and sequences of action. This method is

particularly well-suited for this research because it requires interviewees to specify the actual processes of their work and the history of their involvement with commercial firms and/or their own entrepreneurial activity as their career has proceeded and in the context of shifting national policies, university regulations, and departmental cultures. Interviews lasted between 60 and 180 minutes. All interviews took place in Japanese; I have translated all quotations into English. I recorded and transcribed all interviews and analyzed all transcripts and documents using a modified version of “grounded theory” (Glaser and Strauss 1967; see Tavory and Timmermans 2014). I systematically coded the interview notes and archival materials, allowing themes to arise inductively, but I also attended to literature on practice change in organizations, science and technology policy, institutional theory and global society. I thus recursively moved between data and relevant theory.

### **Trans-Local Repertoires of Action**

Japanese university bioscientists inevitably had extensive communications with the global scientific community. Since academic achievement is measured by publications in peer-reviewed journals, all interviewees publish in major journals in English, attend or organize professional conferences worldwide, and collaborate with colleagues internationally. These collaborations range from the trivial (exchanging mice for experiments) to running a large international project

with multiple labs and grants. Furthermore, because postdoctoral training in the United States (or, sometimes, Europe) is a typical trajectory for promising Japanese bioscientists before assuming their positions in Japan, over half of the interviewees had spent one to five years abroad. Some had held teaching positions for many years in the United States before returning to their country. Despite this wide variation, then, all interviewees' social worlds included the United States. Moreover, all the scientists I interviewed were sustaining relationships with U.S. scientists and firms at the time of the interview.

Studies of returnee entrepreneurship suggests that those who were educated or worked in the U.S. take advantage of the knowledge and resources they acquired during the stay in their home country (Wang 2013), although they could also be penalized from lost social ties or understanding of local norms and circumstances in their home country (Drori et al. 2009). In addition to what one brings back to their home country, however, the ties formed during the years abroad becomes an invaluable part of the returnees' resources (Portes et al. 2002). Thus, the overseas experience not only change a returnee in terms of their cultural, economic, or social capital once and for all, but they may even be able to sustain (and expand on) the social networks they cultivated in the U.S.

Such transnational experiences and networks deeply shaped the ways the Japanese scientists understood and responded to the policy changes. The scientists' transnational experience shaped their responses in two main, interconnected ways. First, exposure to U.S. academic entrepreneurship prepared Japanese university scientists to adjust to the introduction of the U.S.-style environment, even before its legal introduction in Japan. Second, their knowledge and

resources regarding U.S. academic entrepreneurship did not lead them to be simply “more American,” but instead led them to try to simultaneously sustain different modes of practice. Below, I discuss each of these patterns in turn.

### *Learning to Be “American”*

The scientists I interviewed all had at least a minimal understanding of relationship between the Japanese policy changes and the commercialization environment in the United States. The “advanced” world of commercialization was within the realm of their everyday scientific life. Even before the adoption of U.S.-like policies, the first way that these interactions influenced Japanese scientists was as a comparison point. Interaction with the global science community made scientists realize how the distinct the situation in Japan was—especially in contrast to the United States, where academic entrepreneurship and formalized methods of commercialization have been practiced throughout the careers of even the most senior scientists I interviewed. Thus, these scientists did not take the situation in Japan for granted. Instead, they understood it as a specific, contingent, and “Japanese” way of doing things that needed some explaining. Even before the introduction of U.S.-originated formal rules for academic entrepreneurship, the scientists considered the “Japanese” way to be just one among several potential ways of commercializing their work. The natural “taken-for-grantedness” that is often discussed in the literature of institutionalization was absent for these scientists.

Quite often, Japanese scientists' transnational networks had afforded them opportunities to collaborate with academic teams or firms outside Japan. In those cases, direct experience working with U.S. scientists gave Japanese scientists first-hand knowledge of how commercialization works in the United States and, in some cases, how they might apply similar practices in Japan. Their transnational experience made scientists "more American" even before the introduction of changes.

A prominent professor in a medical school told me that as early as the 1980s, he negotiated with firms over the terms of collaboration to ensure that he would be at least a co-assignee of his inventions and would retain formal rights for compensation. When I asked him how he had started to negotiate with firms, he replied:

Well, once I was working with a startup in the U.S., and we had disputes over patenting rights. They were pretty unscrupulous. We coauthored academic publications, but they completely neglected us in patents. We got into disputes and had quite a few negotiations, but it ended up that we would have had to prepare a sum of expenses if we had sued... I brought the idea and reagents; they had a technique to find the [ligand of a neurological receptor]. I knew if we looked for it in such and such ways, we would find it. They had the technique, so we asked if they were interested in finding it with us. So the idea is completely ours, but they submitted patent application without our knowledge. So they are not like in Japan, not gentlemen-like.

The professor reasoned that his experience working with a U.S. firm that had neglected his contribution to the intellectual property they created had made him cautious of trusting firms.

Although this incident happened when he was in Japan, this interaction with a U.S. firm led him to reflect on how he should handle working with firms in general. He regretted that he had sent the materials in good faith, without a formal contract. This experience had made him learn to be legalistic afterwards, even with Japanese firms. Although he claims that the reason for the problem was precisely that the U.S. firm was not as gentleman-like as the Japanese firms who abided by informal agreements, he then transposed American practices to the Japanese context.

After this experience, he still used the donation scheme to work with Japanese pharmaceutical firms (that was the most practical option then), but he always negotiated to secure some rights to any inventions that arose from collaborative research. Thus, even before the Japanese Bayh-Dole Act, he negotiated with a pharmaceutical company to have half the right to the patent (as a joint patent assignee) that came out of a collaborative research project, although many professors at the time customarily waived any rights to the patent, in expectation of large donations.

Indeed, later in the interview, this scientist argued that his experience with U.S. and Japanese firms led him to believe that the previous informal system of collaboration was detrimental to professors, who do not have resources to protect their rights. He said, “There is a tradition in Japan to trivialize scientists” and welcomed the adoption of the American system. At the time of the interview, he was in a governmental advisory position and had been promoting the formalization of commercialization practices. But even before that, he tried to have clearer contracts with more formal patent rights, to the degree that it was possible in the Japanese environment before the policy changes. Thus, lessons from his exposure to U.S.

commercialization made him change his practices in Japan well before the legal and institutional changes were introduced.

The experience of a biochemistry professor further shows how exposure to American resources and methods of academic entrepreneurship led scientists to think in more “American” ways. He had worked in a medical school in the United States for ten years before returning to Japan to assume a position in biochemistry department in 2005.

Donations are not collaboration. I came back to Japan and found that practice so wrong. It’s not right to be funded and return nothing. I refuse to do it and only conduct collaborative research with them having first-refusal rights. I say, “Isn’t this the right way?” [...] so I say, “Stop using donations, it’s from the Stone Age!”

As a returnee, he absolutely refuses to use what he sees as “Stone Age” practices of academic entrepreneurship; instead, he helps propel the transition to the new, American, formalized practices. In the United States, where he worked for ten years, he had actively licensed several of his inventions, and he recounted how the Office of Research of the U.S. medical school had negotiated the terms of licensing. He had finished his PhD in Japan, but since he went on to have a postdoc and then a faculty position in the United States, he had no experience in informally interacting and collaborating with firms. For him, the old Japanese way simply looked out-of-date, ineffective, and morally dubious. As with the previous interviewee, he now helps the university operate the new, formal system of academic entrepreneurship—he introduced the



technology licensing staff of the Japanese university to the Office of Research of the former employer, so they can learn the “better” way of doing business.

These cases show straightforward effects on Japanese bioscientists of living in the United States and of interacting with U.S. firms and colleagues. Constant interaction with a global scientific community, especially with the United States, prepared Japanese scientists for the government-initiated introduction of the U.S. structure of academic entrepreneurship. For many of them, by the time the policy was finally adopted, it was “old news.” A few of them, moreover, already practiced more contractual, formal procedure for academic entrepreneurship; these scientists believed that the change was long overdue and that the previous informal practice of working with firms through donations was detrimental and should not be used.

As these examples show, the implementation of global policy is not necessarily a shock to the local actors in adoptee countries. In fact, these “local” actors may not be exclusively local at all; they often are trans-local in that they travel across national boundaries and have cosmopolitan orientations (Saito 2005). In the case of scientists, being part of the scientific community is an inherently global affair (Fourcade 2006). Studies of global diffusion tend to presume that local adoption requires negotiation and compromise between the “indigenous” and the “global.” It is certainly true that some Japanese bioscientists were conflicted about the move from the previous, informal practices of working with firms and receiving donations (Kameo 2012). In addition, the relationships they had already created with firms sometimes drove them to try to keep using the old practices. The interviews reveal, however, that the scientists’ transitional experiences played a large role in how they understood and responded to the changes. Next, I show a more salient

way that the global social world shaped scientists' responses to policy change—one that exemplifies the multiple, complex ways that the global social world affects local adaptation of policy.

### *Here and There: Two Worlds*

Although some Japanese scientists took to the formal, U.S.-originated system very quickly, others were proficient in both the American and the Japanese systems of academic entrepreneurship and stated that they liked to choose, on a case-by-case basis, on which side of the national boundary to work on commercialization. Of the forty scientists I interviewed, only five claimed that they only use the formal collaborative methods, while seventeen explicitly mentioned that they still use the donation scheme. It is likely that some of the remaining eighteen also continue to use donations for commercial activities but refrained from admitting it; therefore, it seems safe to say that scientists tend to maintain both repertoires of entrepreneurial action.

Like the interviewees above, many of these scientists were “returnees” from U.S. academic institutions and had worked in the U.S. commercialization world for many years. Some had formerly been affiliated with U.S. institutions, and some maintained ongoing collaboration with U.S. colleagues. These interactions with U.S. colleagues afforded them knowledge of U.S. commercialization practices and the ability to enact some of these practices in Japan. This interaction also allowed them to develop a repertoire of commercialization strategies that encompassed the traditional, informal Japanese practices; the new, formalized Japanese

practices; and the U.S. practices. Some scientists noted that working in the United States or with the U.S. firms actually made them appreciate what they believed to be the benefits of the informal Japanese system.

One interviewee, a systems biologist, had spent five years as a postdoc in the United States and had worked with venture capital and started an investment consulting firm. He attributed his business skills to his experience seeking corporate funding for his postdoctoral training. In his second year, the lab he had a position ran out of the NIH funding, which had been the source of his salary. To continue his project, he had to find an investment firm to fund another professor so that that professor could hire him as a postdoc and he could continue to pursue his own research. This maneuvering and other consulting gigs he juggled during his postdoctoral years were fundamental to his familiarity with the business world. Now, back in Japan for over ten years, he interacts with Japanese firms and runs his own biomedical startup. He told me that he was satisfied with his commercial engagements. When I asked if the informal Japanese practices are detrimental, he said:

People are sensitive to what is valuable. If someone says [that the Japanese donation scheme is disadvantageous to scientists], you should take it with a grain of salt. Rather, the Japanese and American systems are completely different, and in Japan, IPs systematically flow from universities to large companies, and they feed back stable support, though it might not be obvious. It's a proper win-win relationship.

He stated that the “Japanese way” was at least as good as the American way, and suggested that scientists who say they are undercompensated might not be providing value to firms, since firms

are “sensitive to what is valuable” and thus would reciprocate fairly. He, in fact, was using both the new, formal, “American” system and the informal “Japanese” system of academic entrepreneurship. He established a startup for therapeutics in Japan, and some of his patents are co-owned by his firm and his university. But he also has inventions whose patents are wholly owned by large Japanese pharmaceutical companies. His multiple labs, in return, receive a very large amount of funding from those companies, to the extent that one of his labs is actually named after one of these companies.

Whereas this professor mainly works within Japan and with Japanese firms (as well as his own Japanese startup), some professors maintain ties and networks in the United States and continue to leverage them long after leaving the country. An internationally renowned immunology professor said that he started a biotechnology startup with the help of a colleague he worked with during his postdoc in the United States:

I moved from [American public research organization] to [a private medical school], and I had a Taiwanese friend there while I was working there. He said to me, “I wouldn't be able to make it as a scientist; I'm starting a reagent firm, can you help me?” So I gave him all monoclonal antibodies, even the ones I developed in Japan. [He continues to explain his ties to other U.S. firms]. We manufacture 80 to 90 percent of the antibodies from my lab in the U.S. It's cheaper to make it there, more reliable, and the market's ability is very high. [...] We have a few being manufactured in Japan, with [a Japanese pharmaceutical firm], but this is no big deal. [...] This antibody is really attracting attention from

scientists all over the world, and there is a collaborative research offer from [renowned American hospital]. We are also mass-manufacturing this in the U.S.

This excerpt shows how the ties to U.S. commercialization networks and practices formed the ways that this scientist commercializes his inventions. His first-hand exposure to the U.S. biotechnology industry connected him with a network of people who are involved in commercialization in the United States. His friend from the lab has a U.S. startup that provided easy access to the commercialization in the United States. His fluency in American commercialization practices does not, however, mean that his repertoire is limited to these practices. In fact, he continues to work informally with Japanese firms. When I asked how he manages his (many) inventions, he replied:

In our lab, most of the patents are owned by firms. We'd call them and ask if they were interested. They'd do us a favor and think long-term and say that they'd maintain it for us. [Interviewer: Do you get some fees from patents?] I guess so, though I don't think it amounts to a lot. [Company A], they got the IP for us; they'd have received some money. I received some....but not substantial. It's a protein-sequences patent...and also, we taught [Company B] a method to create antibodies without [a type of cell]. They sell them, but we don't make money from it. It wouldn't be elegant to ask for it. However, we do ask them to create all kinds of antibody free of charge for us and for our collaborators all over the world. That's really helpful.

When he commercialized his inventions in Japan, he worked with donations and reciprocal favors. It “wouldn’t be elegant” to ask for formal rewards from the firms to which he had given the rights to his inventions, he stated. Instead, he asked for favors, such as supplying antibodies free of charge, or, presumably, giving the lab donations later on. When I asked him how he felt about the changes in Japanese commercialization policies, he brushed the question off and stated that he prefers to work with donations as long as it is possible for him to do so. In his case, the fact that he had been using U.S. commercialization practices and has startups in the U.S. makes it irrelevant for him that the Japanese commercialization environment is shifting to resemble that of the United States, because he could also commercialize his inventions in the United States.

His mastery in switching between the commercialization worlds of Japan and the United States affords him the ability to commercialize his inventions successfully in two worlds: he can choose to develop some inventions in the United States, or he can chose to collaborate with Japanese firms, exchanging IP rights for informal returns. His involvement with U.S. academic entrepreneurship thus did not make him more “American”—in other words, he did not especially favor the more contractual, formalized method of commercialization. He emphasized, at the end of the interview, that he hoped that I understood that the “Japanese sensibility” that is “cooperating so the firm can develop next-generation inventions” and not about one-time transactions. Regardless of whether long-term research collaboration is specifically “Japanese,” it is analytically important that he framed it as Japanese, relational, and good, in contrast to American, contractual, and short-term. Likewise, it is significant that he intends to keep using the

old informal practices as long as he can, while simultaneously taking advantage of the American environment.

Here and in other cases, involvement in American-style academic entrepreneurship did not have the straightforward effect of making scientists prefer the formal, American procedures. Instead, it gave scientists access to U.S. resources and networks even long after their stay in the United States had ended, and even, in some cases, when the scientists had never lived in the United States. If their research is considered promising, scientists can get countless offers to work with colleagues or firms internationally. A final example, from a professor of regenerative medicine at a medical school, illustrates the sentiment that the scientists in this section shared—that of “being here and there.” In this case, the scientist’s repertoire included the American environment and the formal Japanese system, but not the informal Japanese system. All the same, his horizon of entrepreneurship encompassed two systems from which he explicitly selected when he sought to commercialize his inventions:

I’m a founding scientist of [an American bioventure]. Now we have one drug with FDA approval, so we’ll be speeding up. [...] They just came all of a sudden in 2001 to our lab; that was the beginning of our relationship. From our perspective, it’s like, we did collaborative research with an American firm and FDA approved it, then PMDA [Japanese FDA] would say, “Oh, if FDA approved it, we will too.” [...] Researchers are the flexible species, in term of this, so we can weave our way through it by international collaborative research. etc.

Although he had only lived in the United States for two years as a postdoctoral researcher, he keeps in close contact with U.S. researchers and the U.S. commercialization world. Due to strong university initiatives for his commercially viable research, he no longer uses the old practices at all; instead, he uses the new, formalized commercialization practices. But that still leaves him the choice between commercializing his inventions in Japan or in the United States. He currently has two large Japanese pharmaceutical companies working on two projects under collaborative research contracts, and, as he stated, he is also a founding scientist of an American biotechnology startup, where he develops his main drug candidate. Fearing that the Japanese regulatory environment would take too long to approve his biomedicine, he chose to bypass some of the Japanese commercialization world, which he can do, since “researchers are flexible species.” He knows that scientists do not have to confine themselves to one site for their scientific and commercialization efforts, so he chooses among different pathways to commercialization on a case-by-case basis.

Japanese bioscientists’ knowledge, resources, and repertoires of practice were not limited by national boundaries. They did not actually need to make a once-and-for-all choice between informal and formal approaches to academic entrepreneurship. Instead, their repertoire of entrepreneurial action was much more complex: they had incorporated the “American way” of entrepreneurship even before the Japanese policy change and without forgoing the informal Japanese system. These scientists did not see much reason to switch from the informal Japanese system to the formal Japanese system, either. Instead, they juxtaposed all three ways of commercializing their work. They saw that each of the three approaches has benefits and



disadvantages and that in some situations, one works better than the others or is more “natural” than the others. Scientists choose from the available environments for their inventions. They are able to bypass much of the Japanese policy and institutional environment altogether while still working in Japan, and sometimes they choose to do so. Sometimes, they continue to work informally with firms with which they have longstanding relationships. And sometimes, they choose formal collaboration and go through TLO for licensing in accordance with the new policy. Most importantly, they were able to, and often did, use multiple forms of commercialization at the same time.

## **Discussion**

This case of Japanese bioscientists helps us understand how transnational repertoires of entrepreneurship shape scientists’ responses to change. This case also advances institutional theory on decoupling of rules and practice in cases of global policy adoption. Studies of policy adoption and the decoupling of rules and practices attribute decoupling in large part to endogenous conditions and practices that are incongruent with the new, adopted structure. Local actors are depicted as negotiating new, compromised practices that take such local contingencies into account. Although this is partly true, my study also shows that there is an aspect of world society that shapes the “localization” of global policy: the trans-local nature of “local” actors.

Instead of assuming that actors are bound to the cultural and institutional constraints of the local, this study shows that Japanese university bioscientists were able to incorporate the practices and

resources of American entrepreneurship into their repertoire of entrepreneurial action even before the new policy was adopted. Their transnational social world gave scientists a number of ways of responding to the introduction of the more formal, U.S.-originated methods of commercialization. Their familiarity and fluency with the American academic entrepreneurial world allowed Japanese university bioscientists to quickly “adjust” to new policies and drove some to dismiss the trust-based, informal, donation method of working with firms even before the introduction of change. In this sense, the influence of the transnational social world was one of “Americanization”—or, in other words, the penetration of world culture to the individual level, already working to mitigate the local differences before the policy imitation (Hannan forthcoming).

But this penetration does not automatically translate into an easier and more precise imitation of core countries’ systems. Not all Japanese scientists who were familiar with the United States abandoned the Japanese informal practices. Instead, because they had incorporated the practices from the core into their repertoires, the “locals” did not feel the need for their country to be identical to the core country. Some Japanese university scientists realized that they could keep the informal, trust-based, Japanese practices while simultaneously taking advantage of the American commercialization world. Some bioscientists then strategized to use both methods for their commercialization endeavors case by case. These scientists did not want to forgo the opportunity to choose from different pathways to academic entrepreneurship. As a result, even after the policy change, they continued to maintain informal, trust-based relationships with

Japanese firms despite their U.S.-based familiarity with contractual relations and official discouragement of the use of donations for commercialization.

These findings enable us to depart from both “the tale of the indigenous” and the model of the rational, calculating, stand-alone actor. Institutional theory has been criticized for depicting individuals in organizations as the simple carriers of institutional culture—what Garfinkel called “cultural dopes” of the organization (Garfinkel 1967; Jepperson 2002). As recent studies of inhabited institutionalism show, actors are capable of making sense of their situations; they use meaning-making systems to respond creatively to new rules (Binder 2007; Hallet 2010; Lawrence et al. 2009), and to expand their repertoire that they then use with their projective capacity to realize certain futures they envision (Emirbayer and Mische 1998). The findings of this study show how actors can leverage multiple repertoires of action. Japanese university bioscientists’ repertoires of action included not only the practices that reflect their local contingencies and environment, but also practices they had learned elsewhere. In a world society, where ideas, policies, and structures flow from core countries, “local” actors are already embedded in a global network of ideas, practices, and resources. Contrary to the picture of cultural dopes, local actors are neither passive nor exclusively local. Instead, they are knowledgeable and creative, and they take advantages of practices and resources beyond those of their own local systems.

The ways that “local” actors negotiated decoupling after policy adoption was thus far from “local.” Ideas, practices, and structures diffuse throughout world society on different levels and thereby prepare actors for policy diffusion. Individuals in world society easily move from one

locale to another, are exposed to different meaning systems and regimes of practice, and develop what political sociologists call “cosmopolitan orientations” (Beck and Sznaider 2006; Saito 2012). Studies of cosmopolitanism make the case that experience in foreign countries changes attitudes toward foreign ideas and people and fosters commitment to global political ideas and dispositions (Calhoun 2003; Phillips and Smith 2008). This study extends this argument by showing that such individuals also learn a global repertoire of practices and resources. Individual exposure to ideas, practices, and resources is somewhat independent from policy diffusion (although both derive from the world society). As a result, “local” actors may already be familiar with the ideas or policy that their country of residence adopts and may already have incorporated relevant practices into their repertoire of action. Actors may maintain transnational ties, practices, and resources, even when they are in their home country. Theory of localization of global policy must then take into account these actors’ global landscape.

This study shows that a transnational repertoire of action does not necessarily conflict with local practices or simply move individuals to imitate the practices of the core country. The effect that transnational experience has on individuals is far more varied than that: it made some scientists “more American,” while others enjoyed the juxtaposition of practices and defended the old Japanese system. Thus, future research should investigate the specific conditions under which transnational repertoires impede, modify, or facilitate the penetration of global structures on an individual level.

As recent scholarship has amply shown, institutional actors can be inventive and creative (Binder 2007; Hallet 2010; Lawrence et al. 2009). But they are inventive through creating and

reinventing their repertoire of actions that depend on their experiences, social ties and resources. Elsewhere (Kameo 2012), I have shown that established social ties and practices did pull scientists to invent new practices that would enable them to maintain arrangements similar to those they had before the policy change. And even when scientists pick and choose from their repertoire of entrepreneurial actions, their choices were always embedded in their pre-existing social ties and situations. For example, some of them worked with Japanese firms through donations while establishing their own startups in the United States. Local practices, feelings of obligation, and accumulated experience mattered as much as the opportunity for a better market and better regulatory conditions for their drug candidates. While the scientists definitely made conscious decisions about which path to commercialization to take, their decisions were informed by multiple ties, meaning systems, resources and opportunities, and case-by-case situations. As we advance the micro-foundation of institutional theory (see Powell and Colyvas 2008) by reclaiming agency in institutions, we need not only to account for strategic, proactive decisions actors make, but also the negotiations that are done in concrete situations, with practical constraints and the “feel of the game” (Bourdieu 1990).

Lastly, the study has implications for the study of the ways in which global structures are recursively made and remade as they diffuse to country after country. Global organizations and professionals play a large role in policy diffusion (Fourcade 2006, Hannan forthcoming). They not only influence whether and when a policy is adopted, but also shape the way it is implemented at the local level. As global professionals incorporate practices and resources in their repertoire in a transnational manner, these professionals’ responses might be baffling and

opaque if we assume them to be only embedded in a locality suggested by national boundaries. The way a policy is practiced is negotiated not between the global and the indigenous – but among local, global and transnational actors, practices and rules, comprising of complex, yet patterned, transnational repertoires of action.

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## **Chapter 3**

### **Knowledge Production, Technology Transfer, and University-Firm Collaboration among Japanese University Scientists in Biotechnology, 1980-2005**

## **Introduction**

This research investigates how policy and institutional changes regarding academic entrepreneurship affected university scientists' academic and commercial activities in Japan. University- industry interactions are a locus of knowledge and technology transfer from academia to industry. Universities are increasingly viewed as not only sites of knowledge production, but also of the capitalization of knowledge, and consequently, economic gain (Berman 2008, 2012; Colyvas 2007; Etzkowiz 1983, 1998; Owen-Smith 2005). Whereas this gradual shift towards more commercially oriented academia has been well-documented in the case of the U.S., and select European countries (see Baldini et al. 2006; Goldfarb and Henrekson 2006; Lam 2010), how other countries adopted the trend needs more empirical studies.

Until about a decade ago, scholars of technology transfer argued that the distance between industry and academia is wide in the Japanese environment. Although Japanese academia in the pre-war period was characterized by its closeness to the industry, the ties between academia, industry and military became heavily criticized after WWII, and national universities' interaction with industry became strictly regulated. Although the restrictions were gradually and constantly relaxed, this setup certainly made the impression that Japanese academia doesn't interact with industry as much as in the U.S. In fact, much of the literature on technology and innovation in Japan focused on either Japanese firm's R&D ability or the policy of MITI (Ministry of International Trade and Industry), confirming (and probably reinforcing) the perception that universities had played only a minor role in innovation and economic advancement in Japan.

Starting in the 1990s, research on university-industry interaction revealed that the Japanese academic environment is not as industry-averse as it was thought to be. In fact, research on Japanese university-industry interaction provides ample evidence that collaborations before the introduction of Japanese Bayh-Dole Act and related measures were simply handled informally (Branscomb et al. 1999), sometimes by "working around" institutional arrangements that formally did not quite presume their existence (Zucker and Darby 2001). Pechter and Kakinuma (1999) compared the university-firm linkage in the US and Japan during 1981-1996 and found that based on the co-publications, the Japanese academia was as active as its counterpart in the US in collaborating with the industry. Similarly, Branscomb et al. (1999) argue that Japanese academia was active in interacting with industry, though using different mechanisms than in the US; Japanese academia managed such interactions by individual-lab and firm-based, informal collaborations. In short, as these studies collectively show, until the initiatives such as Japanese Bayh-Dole Act in 1999 (hereafter "initiatives") Japanese university-industry technology transfer had been managed by informal, gift-exchange like interaction where the scientists and firm collaborative through donations. This informal arrangement meant that most of the industry-academia interactions went untracked by administrators until recently (see Kneller 2003; Zucker and Darby 2001).

Thus, to understand the changes among Japanese university scientists in how they collaborate with firms and engage in technology transfer requires measures that reveal informal relationships between scientists and firms. Such measures are needed not only for an assessment of Japan's commercialization history, but for an assessment of its present. As the policy and institutional



environment started to change in 1999 to encourage more formal engagements , it is an empirical question if the changes had, indeed, increased the scientists' propensity to work with the industry, and if so, how.

Previous research on university-industry interaction often only tracks university- owned patents and its licensing, or formal collaborative contracts. Although these numbers are certainly valid measures of the rise of academic entrepreneurship, these methods are limited precisely because of the informal nature of Japanese university-industry interaction. Prior to the initiatives, it was common for scientists to work with firms without any contracts through university, and Japanese universities rarely sought out the intellectual property (IP) of the faculty. Additionally, the impact of the initiatives on practice change among Japanese university scientists are still unclear; that is, researchers should not assume that the scientists simply abandoned the informal practices after the initiative was adopted. In fact, anecdotal evidence suggests otherwise (Kneller 2003). Given the likely prevalence of informal practices, the number of university patents is unlikely to be a good indicator of changes in scientists' propensity to academic entrepreneurship, as informal technology transfer – including the faculty inventions that were patented by collaborating firms – will not be captured by such a measure.

This essay overcomes this problem by using the number of co-publications between Japanese university scientists and firms, and the number of patents where Japanese university scientists are inventors. The number of co-publications shows the bench-level research collaborations between university scientists and firms (Zucker et al., 1996; Zucker and Darby 2001), regardless of the form of its collaboration – if it was informal or formally agreed by contracts through university;

similarly, for the patents, by looking at patents where the university scientists are inventors, we track all the inventions that the academics were involved regardless of whether it was applied by the firm scientists collaborated with, the university, or both of them. The study is exploratory in the sense it aims to ask a set of open empirical questions. First, how, and how much, did Japanese university scientists collaborate with firms before and after the initiatives? Did the initiative have any effect on increasing (or decreasing) university-industry interaction? Second, how should we understand the relationship between Japanese university scientists' scientific productivity and their industry involvement? Are they at odds with each other, co-exist or reinforce one another? What is the relationship among faculty inventions, their industry-interaction, and scientific production?

To answer these questions, the rest of the essay proceeds as follows. The next section briefly summarizes the initiatives that the Japanese government implemented between 1999-2004 to increase formal university-industry collaboration and technology transfer, and literature regarding policy impact on university-industry interaction in the US and other countries, patent-publication relations in academia, and the empirical works previously done on university-industry interaction in Japan. Then we describe our data and methodology, followed by results and discussion.

***The Japanese Bayh-Dole Act, other initiatives, and university scientists' articles, collaboration and patents***

The Japanese government maintained a rather hands-free approach to the interaction between university scientists and faculty until the late 1990s. Historically, because national universities were publically-funded (and more than 80% of research universities are national), overt collaboration with the industry was discouraged – especially after World War II, when admonitions against interactions between the (militarized) government and the university were marked. Although the government did establish some guidelines and regulations that enabled university-industry interaction in 1970s and 80s such as the notification on donations in 1978, or notice on collaborative research in 1983, the interaction between university and industry was often managed on individual-scientist level, making use of donations and informal collaborations that will be discussed in detail below.

Starting in the 1990s, Japanese government officials increasingly began to see Japanese technology transfer as suboptimal. Following the Science Basic Act in 1995, the Japanese government implemented a series of legal initiatives. The Japanese Bayh-Dole Act—the equivalent of US Bayh-Dole act that allows universities and other entities to be patent owners of findings out of nationally funded research—enacted in 1999. Another act, the “TLO Act,” enacted just before the Japanese Bayh-Dole Act in 1998. This allowed approved technology licensing offices (TLOs) to start up their operation with governmental aid. In accordance with these changes, both public and private universities gradually started to claim IP rights to inventions that resulted from their faculty members’ research – thus practically cancelling the 1978 MEXT notifications. Similarly, the restriction regarding dual employment of public employees began to relax in 2000 to enable national university scientists to be involved as board

members of businesses that were related to technology transfer. The final step to this repositioning of academic entrepreneurship was the National University Corporation Act in 2004. This act gave national universities individual corporation status and allowed them to freely develop their own strategies regarding university-industry collaboration. As these policy initiatives came one after another, (and there is virtually no control group among Japanese university scientists), it would be difficult to single out the effect of one policy change. Thus in this article, we take 1999 – the year Japanese Bayh-Dole act had passed – as the year in which the series of initiatives came into effect, as that change crystallized the commitment of Japanese government towards a more entrepreneurial university (Etzkowiz 1998).

Although government reports and other research on Japanese university-industry interaction tend to claim that the initiatives had direct impact on increasing faculty's involvement with commercialization, we need to be careful in assessing those claims (MEXT 2010; METI 2010; University of Tokyo 2012; also see Motohashi and Muramatsu 2012). Since much of university-industry interaction was managed through informal routes, and since university patenting was extremely rare until 1999, or even until 2004 – when national universities acquired corporation status – testing increases in university-industry interaction needs to take special care to incorporate measures that can be used both before and after the initiatives.

### *Studies of the Bayh-Dole Act*

Studies of the policy impact on the rise of university-industry interaction show that such policy intervention may have limited effects. Academic entrepreneurship in the U.S. was a complex shift from academia as a site of knowledge production to a site for knowledge production *and*

economic success. Thus, although policy changes may have reinforced other contemporaneous changes, they did not necessarily themselves drove the university scientists to be more entrepreneurial. The innovation (mainly the birth of biotechnology), the change in academics' willingness to engage in commercial activities, legislation, university administration and industry needs all interacted to construct a new, more commercially oriented, academia (Berman 2012). Thus the Bayh-Dole Act is only one of the many factors that contributed to the institutionalization of more commercially oriented academia; practices, rules, and institutions largely co-evolved. (Mowery et al. 2001; Shane 2004). Indeed, the Bayh-Dole Act was shown to have had little effect on the increase in academic entrepreneurship itself (Henderson et al., 1998; Mowery et al., 2001; Mowery and Ziedonis, 2002).

Whereas the modest impact of the Bayh-Dole Act on universities is established in studies of U.S. academia, the effects of similar initiatives in other countries are still actively studied. The successful institutionalization of academic entrepreneurship in the U.S. resulted in its diffusion worldwide, and by 2010, many other science and technology intensive countries adopted measures that are equivalent to the U.S. Bayh-Dole Act (AUTM 2014)<sup>9</sup>. In these cases, the Act was largely an external shock to practices of the academia-industry interactions. And, as an external shock, the question of how the Act (and the shift towards more formalized methods of technology transfer the Act symbolizes) impacted academia is an empirical question.

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<sup>9</sup> AUTM, the Association of University Technology Managers, lists the following countries for the ones who implemented a Bayh-Dole Act equivalent: Brazil, China, Denmark, Finland, Germany, Italy, Japan, Malaysia, Norway, Philippines, Russia, Singapore, South Africa, South Korea, United Kingdom as the countries that instituted a similar Act.

Moreover, since these countries adopted the U.S. form of academic entrepreneurship later than the 1980s, there were already other mechanisms of university-firm collaboration active in these countries before the change. Thus, the measures useful in estimating the activities of university in the United States are often inadequate for other countries. For the studies of the United States, researchers often use the trend of university-patenting – patents where the faculty is an inventor and the university an assignee. But for such late adopter countries this measure is partial, because the university scientists had already developed means of patenting through industry-collaboration without university's patent ownership.

Studies of the rise in academic entrepreneurship in European countries repeatedly show that the effect of the adoption of the U.S. style entrepreneurship is complex. In France, Lissoni et al (2008) reports university patenting rose after the Innovation Act (the Bayh-Dole equivalent) but more than half of the patents by university scientists are still owned by business companies. Geuna and Rossi (2011) provide a similar finding in the cases of Denmark, France, Germany, Italy, Netherlands, Sweden, and the UK – although university patenting is on the rise, the number of faculty-invented patents owned by firms still exceed that of university-owned patents during 1994-2001.

The studies of Japanese academia are still inconclusive precisely because they use university-patents as the measure of academic entrepreneurship. There is no doubt that the introduction of the US style entrepreneurship increased formal collaborations between the university and the industry, as the number of contracted collaborative research, university-patents rose (Goto and Motohashi 2007.) But evidence regarding the net increase of all university-industry interaction,

including informal collaboration and firm-owned patents is scarce. Motohashi and Muramatsu (2012), for example, use the number of patents where Japanese university scientists are inventors as their measure of industry-academia interaction. They show that patenting activity by university scientists significantly increased after 1999, but without controlling for the increase of the Japanese university scientists itself over the study period, it is hard to conclude that the initiatives themselves had direct impact on such increase. Summarizing, understanding how the initiatives affected the Japanese university scientists' propensity to collaborate with firms and patent, we need a more detailed dataset containing university-firm co-authored articles and individual-based data on patents, to be able to include university-firm interactions conducted informally without university administration ; we thus use panel dataset of 1,953 Japanese university scientists to delineate the relationship between the scientists' publishing and patenting behavior over the study period.

### *Studies on publishing and patenting*

Researchers have hypothesized that increased entrepreneurial activities by university scientists may negatively affect their scientific production. This hypothesis is based on two considerations. First, if university scientists make more effort in their commercialization pursuits, there may be less effort allocated to their own academic research; secondly, scientists' research quality may be adversely affected by their choice to work on a more applied topic (Dasgupta and David 1994; Nelson 2004). Such claims, however, are largely unsupported by studies of university scientists in the United States and Europe. Studies of US scientists consistently show that the more

productive scientists are in publishing high-quality articles, the more patents they produce (Agrawal and Henderson 2002; Azoulay et al. 2007; Hicks and Hamilton 1999; Markiewicz and DiMinin 2004; Owen Smith 2003; Thursby and Thursby 2003). Studies in Europe also seem to replicate this finding, although most research uses either survey methods or single-site study, making their results somewhat less generalizable. Looy et al. (2004) argued that the relationship between publication and patents is a reinforcing one in Belgium. Other studies such as Crespi et al. (2008) on the UK, or Breschi et al. (2005) on Italy provide support for the positive relationship between publishing and patenting. However, Geuna and Nesta (2003) call for more comprehensive research on the effect of patenting on academic activities in Europe, taking its historical contingencies into account; that is, because many European countries have had system of business ownership of IPs, tracking faculty's inventions – and their effects on the publication record and vice versa – had not been adequately studied.

Studies of Japanese academia in terms of publication-patent relations face similar problem. Motohashi and Muramatsu (2012) shows that about half of the patents Japanese university scientists were involved in were still owned only by firms (and not universities) in 2006; thus, inferring the patent-publication relationship by using statistics on university-owned inventions would be an empirical mistake. As far as we know, there is no study that directly addresses the relationship between patenting and publishing behavior among Japanese university scientists. We are thus the first to investigate whether the “hybrid order” – the synergy between academic and commercial systems (Owen-Smith 2003)– is applicable to Japanese academia, where historical and institutional differences from the US are striking. By using individual-based panel



data, we investigate the relationship between the Japanese scientists' former publication quantity and quality and their patent production.

## **Data and Methods**

We use an original dataset based on the COMETS database created by Lynne. G. Zucker and Micheal Darby. In addition to publically available data, we compiled an individual-based panel dataset for the 2,203 Japanese university scientists active during 1980-2005 who met the following criteria: 1. The scientist is one of the highly-cited (ISI) researchers and/or has at least one article that is classified as High-Impact at ISI Thompson-Reuters. 2. The scientist has at least a one year affiliation to a university in Japan. This measure is taken for the purpose of selecting a pool of highly capable academic bioscientists in Japan, who are the targets of the policy measures discussed above. After obtaining the list of scientists, we eliminated those scientists who only belonged to Japanese universities for less than three years in their entire career. The total number of scientists was thus reduced to 1,953. Although at this point we cannot track the changes in institutional address the scientist belonged to, given the relative stability in Japanese academia we believe this is a relatively reliable population-selection measure.

The dataset contains all the articles the selected scientists published during 1980-2005. The article data has details such as the name and institutional address of authors (including co-authors), publication date, and the types of the institution authors belong to. This enables us to classify articles as co-published with firms, signaling bench-level university-firm collaboration. For patents, the dataset is derived from USPTO patent website – and includes detailed

information such as the patent application date, and the names and addresses of assignees and inventors. This enables us to identify all patents that the university scientists were involved with by tracing the patents for which they were inventors. This dataset thus overcome the shortcomings of previous studies that only identify patents that have universities as patent assignees. Although another possible option for the study of patenting activity is to look at the patents filed in Japan, we believe the use of the US patent base is warranted for two reasons. First, whereas Japanese scientists and firms often seek to patent inventions for various reasons – for preventing use by other companies or to boost up their R&D statistics – they tend to seek to secure IP rights in the US only if the invention is valuable and commercializable, because applying for and maintaining US patents is a more costly process. Secondly, there is no comprehensive public database for Japanese patents that include detailed information such as inventor name and inventor address (Japan patent office has not digitized the detailed patent information before 1993.) By using USPTO database, we were able to compile the granular information such as the inventor name and address, patent classification, and so on. All variables are on individual-level.

The summary statistics is shown in Table 1 and 2. The trend of total number of articles published and total number of patents by university scientists are show in Figure 1.

### Dependent Variables

*The number of co-publications a scientist had with a firm(s) in a given year:*

As the introduction made clear, the number of co-publications is the best measure that can be used to trace bench-level collaboration between university bioscientists and firms. We expect that scientists will have more patentable inventions as collaboration increases, measured by the number of co-publications. Thus, the second model includes the following dependent variable:

*The number of patents where the scientists is an inventor.*

Before the Japanese Bayh-Dole act and other initiatives, Japanese university scientists historically gave away the rights for their inventions to firms, in expectation of later favors. Thus, the most consistent measure to quantify the commercialization efforts by scientists is to trace the patents where the university scientists are listed as an inventor. Whereas assignees of faculty inventions can be various entities, inventorship in the US is legally bound to be allocated to those who contributed to the inventions intellectually. A quick look at the dataset revealed that even in 2005 – the last year of the dataset – 30 out of 41 patents were still patented with a firm as at least one of the assignees. Thus, looking only at patents where the scientist's university is (one of the) assignees would significantly jeopardize the results' validity. We take the application year of the patent as the year the invention was created for all granted patents. Because of the time lag between the year patent was applied for and the year it was granted, our patent data is skewed as it is close to 2005 (our original dataset has patents granted by 2010; the average time an application takes to be granted is more than 3 years.)

## Independent Variables

### *Number of publications per year*

The relationship between university scientists' academic activity and commercial activity has been a topic of investigation since the inception of the entrepreneurial university. Skeptics of commercially-oriented academia argue that as university scientists' involvement in commercial activity increases, the quality and the quantity of their academic work deteriorates (Dasgupta and David1994; Nelson2004). These scholars argue that the secrecy that is necessary in commercialization activities may jeopardize their motivation to publish their scientific discovery, or, alternatively, that their work would become more applied and thus lose its academic quality. To answer the question of how academic research quality affects scientists' patent, we consider the relationships between the scientist's number of patents and the scientist's number of publication, and the number of highly-cited publications. We thus test whether the argument on the positive relationship between academic quality of a scientist and their success in commercialization despite significant institutional and cultural differences between the US and Japanese academia.

### *Number of high-impact publications per year*

Related to the number of publications per year, the number of high-impact articles by the scientist per year testifies to the quality of academic knowledge production by the scientist. High-impact articles are defined by ISI Thompson Reuters based on their citation records.

Studies of US scientists show that there is a significant positive relationship between high-quality academic research and patents (Owen-Smith and Powell, 2004; Narin et al., 2000; Zucker, Darby and Armstrong, 2002). While these studies looked at such relationship from the firm's side, this study investigates if the relationship holds for the academic scientists themselves.

*Number of co-publications a scientist had with a firm(s) in a given year*

For the second model, using the number of patents as the independent variable, we also include the number of co-publications. The number of co-publications signify bench-level collaboration, and firms are likely to expect IPs out of such collaboration (Gongras and Goides 2000). Studying Japanese biotechnology firms, Zucker and Darby (2001) showed that when firms collaborate with universities – for knowledge otherwise unattainable – there are large returns in their numbers of patents or products. Thus one might expect the same from the perspective of the scientists: that they benefit from collaboration with commercial entities in acquiring patents. For all independent variables that use publications, we cumulate the number of publications throughout years with the depreciation rate of 0.2 and lag it by a year, to average out the knowledge base of the scientist and the lag between the scientific activity and the publication appearing in print, respectively.

*Number of years a scientist is active*

Scientists are defined as active when they first publish, and leave the dataset when they did not publish for more than two years. Since renowned scientists tend to run labs, receive grants, and thus be named as co-authors in the lab's publications, some scientists in the dataset have more than 50 years of activity, although at the end of the career these scientists might not be pursuing research and commercial activities themselves. Thus the relationship between the number of years being active and the two dependent variables (number of co-publications and number of patents) may be non-linear. Preliminary analysis of our dataset showed that the relationship is indeed non-linear, so we add a quadratic term for the variable in some of our models.

### *The Japanese Bayh-Dole Act*

In the case of the U.S., the change towards more commercially oriented academia should be thought of as a gradual change. In the case of Japan, however, the Japanese Bayh-Dole Act and other initiatives detailed above constituted an external shock to the working informal practices. Not only did it legally enabled universities (and other entities) to own IPs arising out of nationally funded research, it also served as a strong signal that the Japanese government encourages commercialization as part of (national) universities' mission. Thus the initiatives may prompt university scientists to engage in more activity with the industry by legitimatizing such actions. The number of co-publications with firms, and the number of patents where the scientist is an inventor, would increase after Japanese Bayh-Dole Act in that case, although they do not specifically mean the scientists shifted to use the formal collaborative methods (in which case the

patent would be university-owned.) We include this variable as a dummy; before the Japanese Bayh-Dole Act, it takes 0, afterwards 1.

## **Analysis**

We used negative binomial regression with fixed effects because the dependent variables are count variables, and they demonstrated overdispersion. Negative binomial regression with fixed effects does not require the assumption that unit effects are independent from other variables in the model. To account for autocorrelation with time, we included a cubic trend for time. For robustness check, we also considered models with cubic splines and a lagged dependent variable, but the results were consistent with all three models, so we only show the model with a cubic trend for time in this essay. Table 1 demonstrates the number of patents per scientist per year during the analysis time. The table shows that the number of patents a scientist produced each year increased over the study period. To account for the overall increase in university-firm interaction – and the effect of policy initiatives – we first consider a model with the number of co-publications as the dependent variable. Then we continue on to the next model, in which the dependent variable is the number of patents where the Japanese scientist is an inventor.

## **Results**

The results of negative binomial regressions are shown in Table 3 and 4. The coefficients have the usual interpretations: positive signs mean positive association, negative signs mean negative

associations. For Table 3, Model 1 only includes the numbers of articles as an independent variable. Model 2 adds the number of highly cited articles. Model 3 further includes the number of years the scientist is active. Model 4 then includes whether the Japanese Bayh-Dole Act was enacted or not. Model 5 is our final model, and adds a quadratic term for the number of years the scientist is active, to account for the non-linear relationship between it and the dependent variable.

All models show consistent effects for each variable. The number of articles has been consistently positive between models, indicating that the more the scientist is academically productive, the more collaboration with firms he tends to have. Moreover, the number of highly cited articles has a strong correlation with the number of co-publication in all models, after controlling for the number of articles themselves. Lastly, the Japanese Bayh-Dole Act has a positive effect on the number of co-publications with firms after controlling for the total number of articles. Thus, it seems safe to say that the Japanese Bayh-Dole Act encouraged the interaction between university scientists and firms in the most basic, bench-level collaboration level.

Table 4 shows the regression results for the models estimating the number of patents for which the scientist is an inventor. Model 1 only includes the number of articles as an independent variable. Model 2 adds the number of highly-cited articles, and model 3 then further adds the number of co-authored articles with a firm. Model 4 includes the number of years the scientist was being active, and Model 5 finally adds the dummy variable for Japanese Bayh-Dole Act. Model 6 is our final model, and includes a quadratic term for the number of years active.



Similar to the last specification with the co-publications, this model also yielded mostly consistent results in all specifications. The number of articles has been consistently positive in all estimations, although it was only significant in Model 1, 4, 5 and 6. Similar to the previous regression with co-publications, the number of highly-cited articles had a strong positive relationship with the dependent variable – the number of patents. On the other hand, although we expected that the number of co-authored articles with firms would have a positive relationship with the number of patents, it was not significant in most models (Model 3, 4 and 5), and in model 6, the coefficient was negative and significant. The coefficients on the number of highly-cited articles are strong and positive in all models where it is included, as in the Table 3. Japanese Bayh-Dole Act seems to have strong positive relationship with the number of patents produced.

Taken together, we can derive several conclusions from these results. First, based on the results of the three variables concerning articles, we show that the most important factor in predicting university-industry interaction is the quality of academic work the scientist produces. Given that the number of highly-cited articles is highly associated with both the number of co-publications and the number of scientist-inventor patents, and after controlling for the total number of publications, the scientists who are most productive academically seem to be attracting more collaboration with firms, and consequently, a bigger portion of their work is likely to be conducted through collaborative work.

Secondly, Table 4 suggests that whether scientists collaborated with firms in previous years does not matter in predicting the number of patents they produce. We did not observe a strong

correlation between the number of patents and the number of co-publications with firms (all models except Model 6 in Table 4 was not significant; in Model 6, it was negative and significant). Thus, collaborations with firms do not make scientists produce more patents – rather, the direction of inference seems to be that high quality academic work leads to more firm collaborations, and more patents. The “star” scientists – who are extremely productive in scientific discoveries – are those who drive university-firm collaborations, and the creation of intellectual property.

Third, and most importantly, the Japanese Bayh-Dole Act dummy variable was positive and significant for both the number of co-publications and the number of patents. For the number of co-publications, it had strong positive coefficients after controlling for the number of publications, and the number of highly-cited publications (in Model 4 and 5 in Table 3). Thus, after the Japanese Bayh-Dole Act scientists were more likely to engage with firms for research collaboration, regardless of their scientific productivity. Also, the number of patents on which the scientist is listed as an inventor significantly increases after the Japanese Bayh-Dole Act (in Model 5 and 6 in Table 4) after controlling for scientists’ publications and their co-publications. Taken together, we can conclude that scientists tend to have more collaboration with firms, and more patents on which they are listed as inventors after the Japanese Bayh-Dole Act.

## **Discussion and Conclusion**

The analysis leads us to make several theoretical and empirical contributions. Empirically, this is one of the first studies to use individual-level data among Japanese university scientists to examine the effect of Japanese policy changes on their university-industry collaboration and patenting behavior. By tracking the publication and patenting records of 1,953 Japanese university bioscientists throughout the years 1980-2005, the study was able to show how Japanese university bioscientists produce academic work and intellectual property, and how their collaboration with firms modulates them. As outlined in the Introduction, much of the work on Japanese academia either focused on patents that are assigned to universities or did not account for the rise of total size of Japanese academia, making it difficult to firmly conclude that the Japanese Bayh-Dole Act indeed had an effect in encouraging scientists' entrepreneurial activities (cf. Motohashi and Muramatsu 2012).

The study shows that there is a clear difference in scientists' collaborations and patenting before and after 1999. Although one cannot simply reduce the increase in the scientists' collaboration with firms and the patents to one single policy initiative, as many policy initiatives followed after it, it seems that the Japanese Bayh-Dole Act served as a catalyst to shift academic's orientation towards engagement with industry. It is useful to note that both measures used in this study – co-publications with firms and patents for which the scientist is an inventor – are not particularly encouraged in the Japanese Bayh-Dole Act. The Act itself only legally enabled universities and other entities to be assigned a patent coming out of nationally funded research. Collaborations with firms until 2005 (and even in the 2010s) were often managed informally through the use of

donations, and most IPs were still patented by collaborating firms until 2005 (and, again, up until the 2010s). Thus legally speaking, the Japanese Bayh-Dole Act has little to do with the two activities. But the Act was a part of Industrial Revitalization Special Law that was intended to encourage technology transfer from academia to industry. Thus, it seems that the Act signaled institutional change that was happening in Japanese academia –university-industry interactions which were managed covertly and without much policy intervention became a clear and emphasized policy target. It seems that it is this legitimization of university-industry interaction that scientists were responding to. In this sense, the policy initiatives achieve their intended effect – they made Japanese academia a place where interaction with industry is legitimized and further encouraged.

This finding is reminiscent of findings regarding the effects of Bayh-Dole Act in the United States. Despite its iconic status as the harbinger of the university with more commercialization efforts, it has been shown that the Bayh-Dole Act did not actually have a strong impact on the American academia, which was already innovating practices and systems of active technology transfer (Mowery et al., 2001; Shane, 2004). In the pioneering case of the United States, the Bayh-Dole Act was one of the many shifts that institutionalized a more commercially oriented academia. In late adopter countries such as Japan, however, the policy initiatives could contribute to the institutionalization of the new academia by shaping the way scientists perceive commercialization activities.

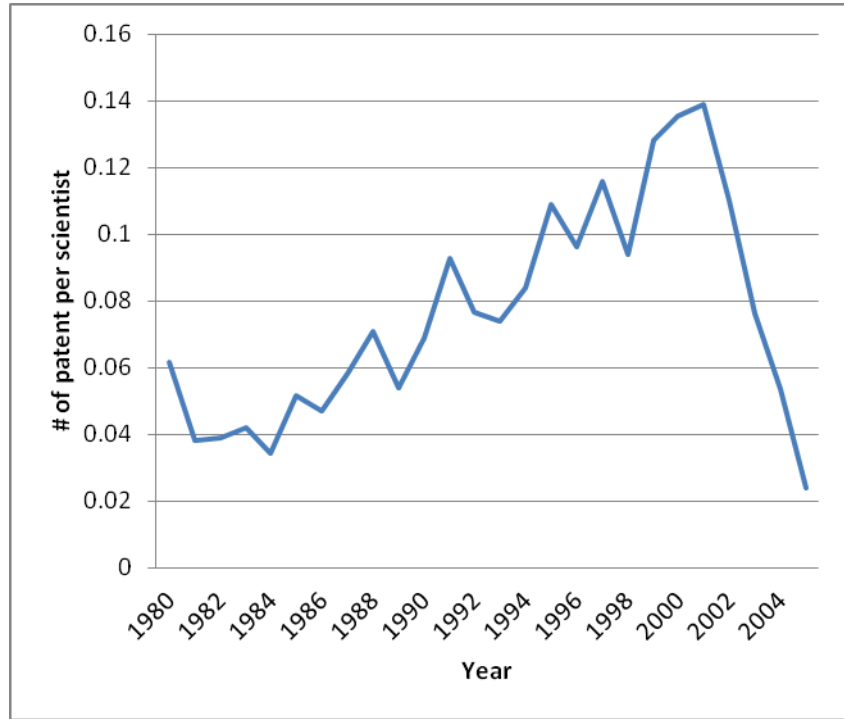
The study also elucidates the relationship between academic achievement and commercialization activities among Japanese scientists. Zucker and Darby (2001) showed that Japanese firms that

had collaborated with star scientists have significantly more patents, R&D, and products in the biotechnology industry. As they argue, “star” scientists are all-round players, highly productive in both academic knowledge production and commercialization success. The findings of this paper underscores this argument, and further elaborates that academic success precedes the scientists’ industry collaboration and patenting activities; the better the science is, the more firms like to work with the scientists, and the more patents the scientist is likely to produce. Somewhat counter-intuitively, collaborations with firms do not increase the number of scientists’ patents, scientific discovery does. It is interesting to note that despite cultural and institutional differences in academia among different countries, studies of academia in Japan – as well as in Europe – seem to replicate the US results. The quality of science and the commercialization go hand in hand.

The essay answers some questions but leaves others open for further research. First, although the essay provides evidence for a positive relationship between scientists’ academic productivity, industry collaboration and patenting, it does not answer some remaining concerns about a commercially oriented academia. For example, possible increasing secrecy and less dissemination of scientific knowledge due to commercial interests, or possible effects on the topic of inquiry scientists choose (Evans 2010ab). It is possible that such problems are developing in Japanese academia, as scientists, policy-makers and general public have paid less attention to these possible repercussions of policy initiatives. Secondly, the data series used in this essay only extends to 2005. It is for future research to investigate a more long-term effect of

the change in Japanese academia by introducing the Japanese Bayh-Dole Act and other initiatives.

Despite these limitations, the article shows the pay off of studying the international institutionalization of more a commercially-oriented academia through measures that accurately assess policy and other regulatory interventions. Substantively, the Bayh-Dole Act was introduced in the US in 1980, when faculty, industry and policy environment were simultaneously starting to create a more entrepreneurial university. The “Bayh-Dole equivalent” in many countries – including Japan– was implemented in much different time and different environment. This study showed that similar policy implementations may have very different impact, namely, serving as a catalyst of the rising legitimacy of commercialization activities. Methodologically, we show the utility of individual-level models that use co-publication among university scientists and patents for which the university scientists are inventors for studying changes in technology transfer and academic patenting. Especially among countries that had long history of informal collaborations with industry and faculty patents without university as an assignee, such measures allow researchers to see changes in collaboration and patenting before and after the policy interventions that introduced more formal collaborations and university patenting.



**Figure 1. The Number of Patents (Inventor) per Scientist per year, 1980-2005**

Variable	N	Mean	SD	Min	Max
Number Articles Co-authored with a Firm	44919	1.691356	2.87324	0	54
Number Articles Co-authored with a Firm (Cumulative and lagged)	44919	6.167351	9.458341	0	103.0334
Number Articles by the scientist in the year (Cumulative and lagged)	44919	37.60996	45.9953	0	357.132
Number Highly Cited Articles by the scientist in the year (Cumulative and lagged)	44919	0.4810194	0.9941771	0	27.62719
Number of Patents the Scientist is an Inventor	44919	0.0768717	0.5644207	0	25
Years being Active	44919	11.56662	7.297566	0	67
Japanese Bayh-Dole Act being Implemented (Dummy)	44919	0.3037022	0.4598607	0	1

**Table 1. Descriptive Statistics for Variables Used in Analysis**



		1	2	3	4	5	6	7
1	Number Articles Co-authored with a Firm	1						
2	Number Articles Co-authored with a Firm (Cumulative and lagged)	0.620	1					
3	Number Articles by the scientist in the year (Cumulative and lagged)	0.547	0.7954	1				
4	Number Highly Cited Articles by the scientist in the year (Cumulative and lagged)	0.233	0.317	0.3529	1			
5	Number of Patents the Scientist is an Inventor	0.079	0.0436	-0.0111	0.0393	1		
6	Years being Active	0.253	0.4628	0.5094	0.2242	0.0146	1	
7	Japanese Bayh-Dole Act being Implemented (Dummy)	0.091	0.2794	0.2897	0.1212	0.0167	0.6867	1

**Table 2. Correlation Coefficients for Variables Used in Analysis**

**Table 3. Negative Binominal Regressions of Number of Articles Co-authored with a Firm**

	Coefficients				
	Model 1	Model 2	Model 3	Model 4	Model 5
Number Articles by the scientist in the year <sup>a</sup>	0.004***	0.005*** (0.000)	0.004*** (0.000)	0.004*** (0.000)	0.004*** (0.000)
Number Highly Cited Articles by the scientist in the year <sup>a</sup>	---	0.043*** (0.006)	0.043*** (0.006)	0.047*** (0.006)	0.044*** (0.006)
Years being Active	---	---	0.074*** (0.007)	0.074*** (0.007)	0.125*** (0.008)
Years being Active <sup>2</sup>	---	---	---	---	-0.002*** (0.000)
Japanese Bayh-Dole Act	---	---	---	0.367*** (0.022)	0.369*** (0.022)
Time	0.028** (0.009)	0.025** (0.009)	-0.044*** (0.011)	-0.007*** (0.012)	-0.051*** (0.012)
Time <sup>2</sup>	0.010*** (0.001)	0.010*** (0.001)	0.010*** (0.001)	0.007*** (0.001)	0.009*** (0.001)
Time <sup>3</sup>	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)
Constant	-0.486*** (0.036)	-0.542*** (0.036)	-0.486*** (0.036)	-0.569*** (0.038)	-0.566*** (0.037)
Log Likelihood	-55595.249	-55570.579	-55513.302	-55373.042	-55102.41
Wald chi2	7045.46	7112.62	7340.32	7690.13	7728.38

Notes: N= 1953. Standard Errors are in parentheses below coefficients.

<sup>a</sup> All article independent variables are cumulated throughout years with the depreciation rate of 0.8.

\* Significantly different from 0 at the 5 percent level.

\*\* Significantly different from 0 at the 1 percent level.

\*\*\* Significantly different from 0 at the 0.1 percent level.

**Table 4. Negative Binominal Regressions of Number of Patents the Scientist is an Inventor**

	Coefficients					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Number Articles by the scientist in the year <sup>a</sup>	0.003** (0.001)	0.001 (.001)	0.002 (0.001)	0.003* (0.001)	0.003* (0.001)	0.005*** (0.001)
Number Highly Cited Articles by the scientist in the year <sup>a</sup>		0.188*** (0.027)	0.191*** (0.027)	0.180*** (0.028)	0.179*** (0.027)	0.139*** (0.028)
Number Co-authored Articles with a firm <sup>a</sup>	---	---	-0.006 (0.004)	-0.006 (0.004)	-0.006 (0.004)	-0.012** (0.004)
Years being Active	---	---	---	-0.064** (0.021)	-0.068** (0.022)	0.102** (0.032)
Years being Active <sup>2</sup>	---	---	---	---	---	-0.007*** (0.001)
Japanese Bayh-Dole Act	---	---	---	---	0.264** (0.001)	0.284*** (0.094)
Time	-0.057 (0.043)	-0.078 (0.043)	-0.080 (0.043)	-0.024 (0.047)	0.008 (0.049)	-0.140** (0.054)
Time <sup>2</sup>	0.017*** (0.004)	0.019*** (0.004)	0.019*** (0.004)	0.020*** (0.004)	0.018*** (0.004)	0.024*** (0.004)
Time <sup>3</sup>	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
Constant	-0.848*** (0.167)	-0.776*** (0.167)	-0.768*** (0.167)	-0.885*** (0.170)	-0.958*** (0.000)	-0.816*** (0.176)
Log Likelihood	-4476.56	-4454.61	-4453.65	-4448.16	-4444.16	-4317.09
Wald chi2	280.35	325.55	326.74	334.92	342.25	390.13

Notes: N= 1953. Standard Errors are in parentheses below coefficients.

<sup>a</sup> All article independent variables are cumulated throughout years with the depreciation rate of 0.8.

\* Significantly different from 0 at the 5 percent level.

\*\* Significantly different from 0 at the 1 percent level.

\*\*\* Significantly different from 0 at the 0.1 percent level.

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## **Conclusion**

The three essays that comprise this dissertation showed some of the ways in which academic entrepreneurship in Japan is changing. Policy initiatives increased university-firm collaboration and university-originated patents. At the same time, the new structure of academic entrepreneurship that is emerging in Japan does not resemble the one in the U.S. so much. The informal sets of practices Japanese university scientists used to employ when they interact with firms seem quite resilient. When their gift-exchange like practices of working through donations and giving IP rights to firms weren't strictly legitimate anymore, Japanese scientists and firms maneuvered to find a pathway to maintain at least some of such practices. As a result, scientists neglected, partially followed, or worked around within the new rules to keep giving favors to the firms. Donations are still a vital part of university scientists' work life, and scientists still dish out IP rights to firms even when the Japanese Bayh-Dole Act and university regulations tell them to do otherwise. When they do work through the university Office of Research, it is common that university scientists negotiate for the firm so the university will share the IP rights of their invention by making the firm a co-assignee.

Moreover, even when Japanese scientists were used to the American way of formal collaborations, it didn't mean they simply switched to the new formalized procedures for their entrepreneurial action. This was the case with a few scientists, but not many. Instead, most scientists enjoyed having multiple repertoires of entrepreneurial action – and simply picked and chose how they worked with firms (donations? The Office of Research?) and where they commercialized their inventions (through Japanese firms, and let them pay for patents? Ask the University to patent? Use the American startup you have ties with?). Although the new policy

environment did mean that the scientists were more legally bound to go through the formal route, they still selected their entrepreneurial mode of action using different repertoires of action.

Chapter 1 and 2 thus complement each other. By choosing to stick with the informal practices of donations, or letting firms have patents, scientists were not just being rigid and resisting against following the new rules. By the same token, choosing to commercialize the inventions with the startup in the US where the scientist was on the scientific board member did not mean that they gave up on Japanese academic entrepreneurship. The thread throughout this dissertation was the focus on individual action, and thus the practices individuals in organizations enact in relation to institutional, cultural, cognitive, and resource constraints. I thus set aside arguments about structure and agency and the question of whether scientists *really chose* what they did. Rather, both keeping the informal, gift-exchange relationships and taking advantage of friendships in the US were on the horizon of possible next actions for the scientists when they looked for solutions to the pragmatic challenge they faced in their everyday work.

What becomes increasingly obvious at the end of this dissertation is that Japan is probably never going to have the same structure of academic entrepreneurship as does the US. In the Japanese case, the previous informal practices persisted, and, anecdotally, there are more and more university-firm co-owned patents. That is, Japanese universities increasingly claim the IP rights of faculty inventions, but often share such rights with the collaborating firm on the condition that they pay for application and maintenance fee. This is practically a replication of the “good-old ways” of handing down the IPs exclusively to the collaborating firms, as Japanese patent law requires all the assignees to agree to license the invention; the collaborating firm may use the IP

as one of the assignees free of charge (or by paying an agreed upon sum of money), and virtually no competitor can come and license the IP from the university. Japanese policymakers, university administrators, and scientists do not seem to be troubled by this arrangement – in fact, in one of the reports by Tokyo University commissioned by MEXT, it acknowledges “the spirit of Wa (peace, cooperation), skills at collaborative work, [and] high-ratio of co-application [of patents]” as Japan-specific condition of university technology transfer. In essence, they seem to be settling for a structure that has some resemblance to the US one, but is actually more similar to the arrangement the informal practices afforded. Japanese Bayh-Dole Act *allows* universities to own the IP rights of faculty inventions out of nationally-funded research; university regulations stipulate that universities *may claim* ownership to the IP – just like in the US – but if they do so, and how they do so, is a completely different question.

To realize this is to delve into the structure of globalization and the dynamics of local implementation. Looking at other countries around the globe is telling: no other countries that had imitated the US are actually enacting “the American way” despite the initial isomorphic decision to adopt US policies. Thus, these findings are not entirely Japanese specific. As I briefly mentioned in Chapter 1, many European countries still practice firm-ownership of faculty inventions or other ways of handing over inventions. Geuna and Rossi (2011) found that in Denmark, France, Germany, Italy, Netherlands, Sweden, and the UK, still more than half of inventions by university scientists were assigned to firms during 1994-2001. And as in the case of Japan, these countries may be starting to formalize the once-informal treatment of IPs and the possibility of handing over IPs to firms; as the Japanese government-commissioned report itself

notes, some German universities simply require a lump-sum payment for releasing inventions, and firms take the lead afterwards. And, in Switzerland, some universities provide several options for industry collaborations, and the most popular one is that the university releases its claim on faculty inventions with 35% surcharge on overhead costs (University of Tokyo 2011). Summarizing, it seems that the American model in which the university single-handedly owns faculty inventions and aggressively pursues licensing doesn't quite materialize in most other countries that once tried to model themselves upon the US structure of academic entrepreneurship.

We can entertain a few speculations from this starting point. First, perhaps, the American structure of entrepreneurship was a unique historical construct, that does not necessarily work in other economic, institutional or cultural settings. It is not only that the implementation of rules is never straightforward, but also the American structure is an outlier. Berman (2012) argued that the US structure of academic entrepreneurship is the results of growing economic rationalization and neo-liberalism that shaped policies such as the Bayh-Dole Act. Although they in no doubt played a role, looking at negative cases, one may wonder how far this “the takeover by the economic sphere” thesis can go. After all, other post-industrialized societies seemed to have failed to imitate such structure, despite the fact many of them embraced neoliberal policies and economic rationalization. Additionally, policies only go so far; the local actors need to have enacted such policies to actually create and sustain institutions. One may argue that the American scientists in the 1970s and 80s were less prone to pursue their own informal practices, that the higher cost of litigation in the United States prevented firm patents, or that the explosive

success of several patents in the US prompted universities to secure IPs aggressively. It is likely that there was some kind of path-dependency that created and institutionalized the American more-entrepreneurial academia. Although this dissertation is in no way an attempt to answer such questions, it does give a hint that the current state of the US academic entrepreneurship did not necessarily need to happen. As with most other things, sociology tells that “it could have been otherwise”.

Secondly, it seems that we need to consider the relational work scientists and other engage in doing science more seriously if we are to understand the interrelationship between science and commerce. As many Japanese scientists emphasized throughout the interviews, entrepreneurial action for them was separated neither from their scientific endeavors, nor from keeping good relationships with friends from graduate school. Keeping good relationships with professional friends and firms seems to be a recurrent theme in how collaborations and technology transfer is handled in Japan and in many parts of Europe. It is also likely that it is equally important to the US scientists. While the importance of community and social ties for scientific life and scientific discovery has been widely demonstrated, (see, e.g. Crane 1972), few studies of academic entrepreneurship paid attention to the effect of social ties on the decision to be an entrepreneur, or what to commercialize, and how to commercialize (but see Murray 2004; Stuart and Ding 2006).

To conclude, I'd like to close this dissertation by opening it up for further research. First, I would like to deepen my historical account of how Japanese government shifted from a *laissez-faire*

policy regarding academia-industry interaction and came to embrace the US policy of academic entrepreneurship that promotes a more commercially-oriented academia, and show how government officials and the scientific advisory board legitimized the introduction of the U.S. policy of academic entrepreneurship during the 1990-2000s. This micro-history would serve as a background to better understand how a global policy diffuses, gets legitimized and then decoupled in adoptee countries. Second, I like to explore the nostalgia that many Japanese university scientists exhibited during the interview when they spoke about the “good old days.” What did it mean to work within the “gentleman’s agreement” or giri-ninryo (duties and obligations), for the scientists’ work, but also for their selfhood, and the way they managed emotions? And what are they accomplishing by exhibiting the nostalgia for the gift-exchanges during the interview? Third, I want to explore how a new generation of Japanese university enacts practices of academic entrepreneurship. The new generation of Japanese scientists – those who were graduate students or recent PhDs when the changes in legislation happened – seemingly have no prior experience or ties to the industry. How does the new generation of scientists perceive the new environment between academia and industry, and enact their academic career? Does this dissertation capture a transitional moment in the history of commercialization, after which a formalized, more American, system will prevail? Will the hybrid practices I describe in this dissertation, alternatively, become a constant feature of Japanese academia?

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