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Innovation and public space: The developmental possibilities of regulation in the global south

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Abstract

Important product and process innovations are often developed in "public spaces" that promote collaboration and provide shelter from market competition. Given that most collaborative spaces are costly to establish, the possible implications are bleak for economically strapped developing countries. This paper highlights a less conspicuous – if not unknown – source of collaborative space: the regulatory process. Regulators can induce innovation by promoting collaboration across organizational, sectoral, and disciplinary boundaries in the interest of regulatory compliance. This paper documents the innovative consequences of efforts to regulate the use of lead-based glazes in the Mexican ceramics industry and reconsiders several recent studies of upgrading in other countries that appear to have been driven, at least in part, by the regulatory process. Drawing on these cases, this paper makes four primary points: (i) that innovation in regulatory spaces is more common than previously acknowledged and is producing meaningful improvements in product quality and working conditions in developing economies; (ii) that promoting innovation in these regulatory spaces is an important developmental tool for countries that are "regulation-takers" and have many low-tech sectors; (iii) that this dynamic extends current conceptions of regulatory discretion, as well as development literature on state-society synergies; and (iv) that establishing collaborative public spaces as a common conceptual framework is a critical step toward understanding the consequences of social regulation on upgrading.

Keywords: development, global south, innovation, regulation, state-society synergies, upgrading.

Key product and process innovations are often produced not by firms alone but in so-called "collaborative public spaces" that: (i) are sheltered from market competition, and (ii) provide opportunity for cooperation across areas of expertise (Lester & Piore 2004). Such public spaces can be found in the research and development departments of some large private enterprises, but they are commonly associated with universities, quasi-governmental agencies, and public research institutes. Governments not only provide funding for these spaces but also have an important role to play in creating the networks of actors that populate these spaces and shaping their agenda (Ansell 2000; Breznitz 2005; Fuchs 2010; Weiss 2014).

If scholars who point to the importance of these spaces are correct, the outlook for the generation of innovation is bleak in the developing world, where governments lack the wherewithal to foster these sheltered collaborative public spaces. Nearly all public and private spending on research and development occurs in a handful of upper income countries (National Science Foundation 2012; World Bank 2014). Funding and development of university systems and research institutes in developing countries lags far behind their counterparts in wealthier countries (Altbach 2009), and there tend to be relatively few institutionalized linkages between universities, private industry, and public agencies that serve the role of promoting innovation (see Nelson 1993). Finally, bureaucratic competency tends to be of lower quality and less effective in poorer countries (see Evans & Rauch 1999). In short, if there is so little ability to establish innovative public spaces, it is difficult to see much possibility for important product or process innovations occurring in the developing world. Contrary to this expectation, however, I argue that the state of innovation-producing public spaces in the developing world is not so dismal after all. In fact, there is one under-acknowledged source of public space that has high potential for giving rise to innovation even in developing

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economies: the regulatory process – or the formulation and enforcement of state regulations on the private sector. Existing studies have identified the role of regulatory agents in assisting upgrading, but they have not tended to focus on the collaborative public-private nature of these interactions or emphasized that these episodes entail important process or product innovations.

Bringing these studies – and future case studies – under the shared conceptual frame of collaborative public spaces is critical to observing the nature and breadth of this dynamic in the developing world, as well as understanding its potential as a tool for economic and social development. In developing this conceptual frame, I draw together elements from recent literature on regulation in the developing world – including synergistic inputs from public and private sectors (Evans 1997, Ostrom 1997), interactions from groups outside the regulator-regulatee dyad (Hochstetler 2012), and the importance of distributive concerns in regulation (Dubash & Morgan 2012) – with scholarship on the production of innovation in regulatory spaces. As these regulatory spaces are inherently discretionary and ad hoc learning environments, they fit neatly with aspects of "relational regulation" (Silbey 2011), which focuses on fostering compliance with context-appropriate means. In sum, regulatory agents who are able to use discretion to carve out collaborative public spaces may use them to marshal public and private capacities to address technological barriers to regulatory compliance, playing an important role in both economic and social development.

I illustrate this dynamic with a single example of an episode of innovation through social regulation: the Mexican government's efforts to use regulatory law to promote an alternative to lead oxide-based glaze in traditional ceramics production. In its effort to regulate the use of lead oxide, the Mexican government opened a collaborative public space that involved a variety of participants across sectors and organizations in the generation of a viable alternative technology that would both meet regulatory standards and improve marketability. This and other collaborative regulatory episodes are necessarily idiosyncratic and often ad hoc in nature; after all, the generation of innovations is rife with uncertainty (Lester & Piore 2004) and developmental processes often involve sequentially revealed problems (Sabel & Reddy 2007). This variation in detail has prevented the development of a more coherent conceptual frame and analysis of episodes of regulatory public spaces. In fact, there are numerous apparent examples of products and processes being upgraded with innovations derived from regulatory processes. These episodes are the same in type if not in detail, so explicitly laying out a clearer conceptual frame will draw together otherwise disparate studies and help develop the understanding of the collaborative work done in the regulatory sphere.

In the sections that follow, I discuss the potential role of collaboration in innovation and the nature of public spaces and how they are seen to promote collaborative efforts. I then offer an extended example of the use of regulatory public space that arose around the Mexican ceramics sector. In the next section, I discuss other several studies in which the basic collaborative dynamics – if not the case specifics – are comparable and draw out the key similarities between them. I conclude with comments about the potential for regulatory public spaces as a tool for social and economic development and the importance of developing a common conceptual framework for understanding the functioning of these spaces.

1. Collaboration, innovation, and regulation

Collaboration has long been understood to encourage innovation by allowing for the combination of ideas that have not been previously brought together. From an information networks perspective, Burt (1992, 2001) argues that organizational structures that promote the brokerage of ideas between groups or individuals and across "structural holes" allow for the combination of previously uncombined ideas, and, consequently, are likely to generate more innovative outcomes. Studies of business management have repeatedly found that organizations that promote the formation of collaborative networks that include bridges to other areas of technological knowledge or expertise are likely to be more creative, innovative, and learn more quickly. Small manufacturers that have more non-redundant ties outside of the firm have greater access to innovative ideas (McEvily & Zaheer 1999) and are more likely to be able to implement these ideas when they have a more diverse base of customers (McEvily & Marcus 2000). Other studies have found that firms that engage in alliances and joint ventures with other firms are not only more innovative and have higher rates of patent applications (Ahuja 2000; Baum *et al.* 2000), but also experience faster growth in earnings (Baum *et al.* 2000; Koput & Powell 2000) and higher rates of survival (Koput

& Powell 2000; Podolny 2001; Powell & Grodal 2005). In short, there is ample empirical evidence of the value of bridging ties between individuals and groups of varied experience and expertise for the production of innovations.

Lester and Piore (2004) offer a related but distinct view of collaboration, one that emphasizes contingency and learning above the explicit presence of information brokering ties. In their perspective, two complementary processes – "analysis" and "interpretation" – are necessary to the development of innovations. "Analytic" activity is the stuff of management theory historically, the identification of particular problems with a product or technology and the pursuit of immediate, efficient, and concrete steps to solve those issues. In many ways the opposite, "interpretive" activity, is the open-ended, barrier-crossing, collaborative conversation about products and potential changes in technologies. While this latter element may rely on the presence of the bridging ties described above, it clearly emphasizes the more contingent and improvisational process of individual participants learning to combine and use others' ideas.

If this open-ended collaboration is important for innovation, so then is the capacity for enterprises to take part in it without facing the ravages of market competition. Very high levels of competition are associated with lower levels of innovativeness (Aghion *et al*. 2005); one possible mechanism for which is the erosion of "pre-innovation" rents (Aghion *et al*. 2001). Among firms with thin profit margins and low capacities, rather than inspiring long-term research and development processes (i.e. "interpretation"), in the best of cases, this erosion may push short-term solutions and incremental innovations, but it may also inspire corner-cutting, wage reduction, and other low-investment solutions and short-cuts. Sheltering enterprises from the erosion of their pre-innovation profits by competitive pressures allows them – to a certain degree – a longer time frame within which they can engage in efforts to upgrade.

In light of this, government capacity to promote cross-organizational brokering and to create shelters from competition takes on heightened importance. In market economies, the role of state agencies has typically been seen as encouraging innovation within or between firms in the private sector by creating financial incentives for businesses to innovate, such as direct grants and subsidies, targeted tax incentives, and profits protected by intellectual property rights. But the role of the government often goes farther by establishing or sponsoring collaborative spaces, such as universities, research institutes, and public laboratories. Although this "space" may be physical – a meeting room for discussion, a laboratory, an office – it may function more figuratively; it implies situations in which "new ideas and insights can emerge, without the risk that private appropriation of information will undermine or truncate the discussion" (Lester & Piore 2004, p. 122). Universities, for example, have been identified as important public spaces, and while they include physical spaces, they also provide resources – research funds, varied faculty, communications, access to research materials, workshops – that promote the circulation and mixing of ideas.

To date, explicit examination of the regulatory process as a potential public space has been largely ignored. Lester and Piore (2004) describe this regulatory space in these terms:

> The promulgation of a set of regulations is generally preceded by a process in which the need for regulation ["Regulatory Impetus"] is discussed and various interested parties try to understand what exactly is at stake in the regulatory arena, what the society is trying to achieve, what technical and social forces are impinging on that achievement, and how they operate. This is very much a process of *interpretation*, during which the participants move freely back and forth across the goals, the resources, and the technical relations that bind them together ["Statutory Phase" and "Innovation Phase"]. The bureaucratic regulations emerge by freezing this ongoing process of interpretation at a particular moment and casting the problem in *analytic* terms ["Enforcement"]. (Lester & Piore 2004, pp. 137–138; emphasis and labels added)

Open-ended interpretation is important in the regulatory process because of the uncertainties inherent in the development of new technologies: what they will be used for, how the technology may further develop, what the potentials and drawbacks are, how those potentials fit with public needs, the extent to which regulation that protects the public and the firms themselves are necessary. I suggest that there are two distinct foci in this interpretive process, which might be termed "statutory" and "innovative." In the former, the chief concern is with the characteristics and details of the regulatory norm or law. In the latter, the concern is with the manner in which enterprises can be brought into compliance with formal norms. There is not necessarily linear progression from one to the next, and

the movement between these two concerns may be iterative and difficult to disentangle. In most of the cases discussed in this paper (Amengual 2013, excepted), the statutory and innovation phases are relatively distinct, which is likely to be common in situations in the developing world where part of the impetus to regulate particular practices comes from foreign or international standards (Dubash & Morgan 2012).

Insofar as the carving out of these public spaces for innovation relies on the judgment and behaviors of regulatory agents, the role of discretion, pragmatism, and public-private relations come to the fore. A growing literature – fueled in large part by Silbey and her collaborators (Coslovsky *et al.* 2011; Huising & Silbey 2011; Silbey 2011) – has refocused a previous concern with the "responsive" use of discretion (Ayres & Braithwaite 1992; Braithwaite 2006) onto "relational" regulatory behavior. Rather than a more programmatic manner of moving up an enforcement pyramid, "relational regulation" is conceived of as the pursuit of defined regulatory goals by an agent who is "neither the rational, utility maximizing individual nor the rule-governed bureaucra[t], but [. . .] a pragmatic actor who sees her work and herself as a link in a complex web of unfolding transactions and processes" (Silbey 2011, p. 3). In this view, successful regulatory outcomes are frequently a result of committed, careful observation and adaption to local conditions, and the focus is less on programmatic steps toward compliance than on adaptation and flexible governance (Huising & Silbey 2011). As such, regulatory public spaces described by Lester and Piore (2004) fit well with this framework: they are largely ad hoc and inherently rely on the ability of regulatory agents to grasp the nature of the organizations they are charged with regulating, their interrelations, market pressures, and their pathologies and barriers to compliance. Moreover, these spaces may include actors beyond the dyadic relationship between the regulatory agent and the enterprise (Hochstetler 2012), including other interested enterprises, civil society actors (see especially Amengual 2013), and other government agencies (see especially Schrank 2013b). Innovation itself is a highly contingent process, for which there are few hard-and-fast rules. Turning from the more organizational elements of relational regulation – managing discretion (Pires 2011, 2013), the development of a relational orientation among regulators (Huising & Silbey 2011), or how more discretionary forms of regulation coexist with less discretionary forms (Coslovsky 2011; Pires 2013) – this paper focuses on the potential to use that discretion to provide the kind of collaborative and sheltered environment appropriate to developing technological innovations.

In the cases discussed, relatively simple innovations generated within regulatory spaces have impacts that produce both public goods (less pollution, better labor conditions, higher levels of education) and private goods (more marketable products, improved access to markets) (see Schrank 2013a). The production of public goods with combined inputs from state and society suggests a tie to scholars who examined the nature and importance of "state-society synergies" for positive developmental outcomes (Evans 1997; Ostrom 1997; Tendler 1997). Indeed, the synergies that Evans (1997) describes stemming from "complementarity" of state and private sector inputs and "embeddedness" of relations between the two would seem to encompass the "relational interdependence" (Pires 2011; p. 43) described in this scholarship on regulation. Ostrom's (1997) notion of "co-production," for example, identifies the necessity of public and private sector inputs, as well as relations that allow public agents to reach across the divide, understand the knowledge and capabilities of local communities, and design a program that makes use of those strengths.[1] Despite this consistency, however, there are few explicit linkages between the literature on developmental synergies and regulation (Dubash & Morgan 2012). Framed in part as a developmentalist or co-productive effort to promote upgrading, labor conditions, and inequality, this study of regulatory efforts that open collaborative spaces for innovation takes a step toward filling the need for regulation scholars to "work pressures for redistribution into their analytic frame" (Dubash & Morgan 2012, p. 274).

In short, sheltered collaborative spaces carved out with regulatory discretion may allow for uncertainties about the regulation and adoption of emerging technologies to be openly addressed in a manner that aids in the state's role as a regulator of social conditions, as well as a promoter of technological advancement in the private sector. For many small enterprises in low-tech industries, the uncertainties involved in regulatory compliance frequently come down to low technical and financial capabilities. In this sense, there is broad potential to foster relatively simple innovations and upgrading through the collaborative public space provided by regulatory-cum-developmental state agencies. Moreover, combined with the legal backing of social regulations, this public conversation around regulation has the potential to push these low-tech firms toward beneficial innovation in a manner that alternative policy approaches to regulation may not (see Gunningham & Sinclair 1999).

2. Innovating traditional Mexican ceramics

The regulation of the Mexican ceramics sector illustrates what the collaborative public space in the regulatory process can look like and how it may be present in otherwise inauspicious policy environments. In contrast to previous cases discussed in terms of Lester and Piore's notion of "public space," it is a sector that is: (i) very static in terms of generating and adopting innovations historically; (ii) divided into productive units that, by virtue of their small size, isolation, and sectoral disorganization, cannot be thought of as having much meaningful internal or inter-firm collaboration; and (iii) located in a country that has done little to develop positive industrial policy for upgrading in small enterprises (Shadlen 2004). Thus, it would seem to be a case with very little potential for interpretive space; however, despite the inauspicious conditions and apparently negative policy environment, a meaningful innovation was generated for the sector within the regulatory process.[2]

Moreover, this case is more akin to other industries in the developing world than to the high-tech sectors that have been examined using Lester and Piore's (2004) insights. These industries are smaller, less innovative, poorly organized into business associations, and typically lacking the kind of political influence that might translate into favorable industrial policy (Shadlen 2004; von Tunzelman & Acha 2005).[3] Additionally, economies in the developing world, and Latin America in particular, are notable for their degree of dualism (Franko 2011). The ceramics sector is typical of the less-developed portions of the economy, where there is a great deal of benefit to be derived from upgrading enterprises in the trailing edge, and informational and financial barriers to innovation are high. For example, small, low-tech, and frequently informal enterprises tend to produce relatively more pollution than larger industries (Lanjouw 2006; Blackman 2006a) and that pollution tends to disproportionately affect poor communities (Lanjouw 2006). Finally, small and micro enterprises provide the overwhelming majority of work opportunities in the developing world and, consequently, the upgrading to the use of modern and safe technologies among them has the potential to improve working conditions for a vast number of workers.[4]

The following sections present the case of the prohibition of lead oxide use in Mexico, from the regulatory impetus through the beginning of the enforcement (i.e. "analytic") phase of the effort (summarized in Table 1). The

Table 1 Phases in process of regulating lead oxide use

	Phase	Rough dates	Major events	Primary parties
"Interpretation"	Regulatory Impetus	Late 1980's–1991	Pressure for regulation of lead-oxide in ceramics sector from international and domestic scientific and environmental community; perceived need to harmonize with trade partners (esp. NAFTA)	World Health Organization; Group of 100; Mexican trade partners; Mexican SSA
	Statutory Phase	~1992–1993	Conversation about need for regulation, who would be targets of regulation, presumed outcomes; Issuance of original standards (NOMs)	SSA; Cofepris
	(Premature Enforcement)	1993	Effort to begin administration of published standards	Cofepris
	Innovation Phase	1994–2001	Exploration of existing alternatives to lead-oxide; Fonart-initiated discovery of alterative glaze; field testing and refinement	Fonart; UAM-I; glaze producers (Cerámicos San José, Macesa); field testers; ceramics workshops
"Analysis"	Enforcement	2002–Present	Efforts to bring ceramics workshops into compliance through cluster training (see Samford 2012b)	Cofepris; Fonart; field trainers; workshops

Cofepris, Federal Commission for the Protection against Sanitary Risk; Fonart, National Fund for the Advancement of Artisan Goods; NAFTA, North American Free Trade Agreement; NOMs, normas oficiales mexicanas (Official Mexican Standards); SSA, Mexican Secretary of Health; UAM-I, Universidad Autónoma Metropolitana (Autonomous Metropolitan University).

data for the study were drawn from interviews and personal communications with involved parties: the Director of Lead Free Program in the Secretary of Health's enforcement arm Federal Commission for the Protection against Sanitary Risk, (Comisión Federal para la Protección contra Riesgos Sanitarios, Cofepris), the National Director of the Lead Substitution Program in the National Fund for the Advancement of Artisan Goods (Fondo Nacional para el Fomento de las Artesanías, Fonart), leaders of a non-governmental organization that arose out of the regulatory process, lead-free glaze trainers, and ceramics workshop heads. It also draws on published and unpublished reports on the process provided by Fonart.[5]

2.1. Regulatory impetus

Until the 1990s, generations of small producers of ceramics in Mexico relied on the use of toxic lead oxide glaze without regulatory oversight. The use of this technology caused widespread lead poisoning among laborers, contributed to the contamination of soil and water, and exposed consumers of these products to lead (Secretaría de Salud 2003). In a globalized context, governments have become not only regulatory rulemakers but also rule-takers in that they feel pressure to harmonize their domestic laws and regulations with those of foreign countries and markets (Levi-Faur & Jordana 2005; Streeck & Thelen 2005; Levi-Faur 2011; Dubash & Morgan 2012). This foreign pressure was part of the impetus to begin regulating lead oxide use in Mexico. Concern with the regulation of lead increased in the 1970s, spurred by studies that clarified the toxicity of lead. The Joint Food and Agriculture Organization/World Health Organization led the international consensus on Food Additives, which established its first recommended limits on lead intake in 1972. As a result of these and tighter regulations established in 1991, the United States (US) Food and Drug Administration (FDA) began inspecting incoming shipments of tableware for levels of leachable lead and detaining those found to be in violation of the accepted levels (FDA 2005), thus effectively creating a standards-based barrier to Mexican ceramics entering the US and other foreign markets. Domestically, a local media campaign led by the "Group of 100," a Latin American environmental advocacy group, identified lead oxide glaze used in the ceramics sector as one of the key sources of environmentalcontamination and advocated for its elimination. The move to regulate lead oxide use was a reaction to these pressures, against the backdrop of a broader movement to pave the way for the North American Free Trade Agreement by harmonizing laws with North America.

2.2. Statutory phase

By the early 1990s, these congruent institutional, economic, health, and environmental concerns led to the publication of official regulations against the production and use of lead oxide glazes in ceramics in Mexico. In drafting the regulations, the Mexican Secretary of Health (Secretaria de Salud; SSA) and its enforcement arm, Cofepris, approached the issue as a question of labor safety, although the regulations would simultaneously eliminate concerns with consumers, the environment, and trade. The SSA and Cofepris drafted legal norms that would restrict the use of lead across a variety of industries, including the traditional ceramics sector (NOM 004 and NOM 011).

Once the SSA had published the new restrictions on lead in 1993, it sought to move toward enforcement, or, in Lester and Piore's (2004) terms, from the interpretive formulation of regulation to the more "analytic" phase of administration. The prior phase entailed the interpretive activity they describe, the interplay between the perceived value of regulating lead use for environmental reasons, public health costs to workers and consumers alike, the desire to harmonize policies for international trade, and private sector incredulity about the toxicity of lead. The putative end of this conversation came with the SSA's decision to include traditional ceramics production in the industries under the purview of the new regulation, weighing public health and the need to harmonize laws with trade partners over the potential difficulty of meeting the new restriction. In moving into the enforcement phase, Cofepris' original plan was simple: the new restrictions would be publicized and ceramics workshops would be asked to sign an agreement indicating their cessation of lead oxide use.

2.3. Premature enforcement

A punitive command-and-control approach (see Gunningham & Sinclair 1999) to enforcement of the new regulation would likely have created the kind of hardship for the ceramics producers that opponents of regulation typically identify. Traditional ceramics workshops are stunted in terms of innovativeness, a fact betrayed by the age of many of the technologies they use; lead oxide glaze, for example, was introduced during the Spanish colonial period (Dietz

et al. 1991). They embody many of the characteristics of small, low-tech industries – such as low profit margins and low levels of human capital – that act as barriers to innovation (von Tunzelman & Acha 2005), and, unlike the firms identified by Ambec *et al*. (2013), the presence of a restriction alone would have done little to allow them to overcome those barriers.

The regulatory agents in the SSA and Cofepris had little to no experience working with the traditional ceramics workshops; in fact, these enterprises – long defined by the government as secondary economic activities – had not previously been subjected to any labor or environmental regulations. Cofepris agents recognized their need to rely on the expertise of other state agencies for successful enforcement; yet the simple process they imagined appears to have ignored the "exigencies of practical action" that would inhibit compliance (Huising and Silbey 2011, p. 15). In 1993, Cofepris brought together a working group consisting of representatives from a wide variety of state and federal agencies that had varied interests in the communities where ceramics workshops were clustered.[6] These agencies were asked to contact workshops, inform them of the new statutes, and request that they agree to the cessation of lead oxide use.[7] While voluntary cessation of *use* at the workshop level would be sought by these related agencies, Cofepris would pursue prohibition against the *sale* of lead oxide-based ceramic glazes.

Rather than beginning the administrative ("analytic") phase of lead use, however, the participation of the agencies in the working group reopened the interpretive process. Cofepris' plan simply took an international norm and sought to impose it upon an industry that was ill equipped to meet the regulation. It was reportedly met with incredulity, particularly among representatives from agencies like Fonart and the National Commission for the Development of Indigenous People (Comisión Nacional para el Desarrollo de los Pueblos Indígenas, CDI) who were more familiar with ceramicists' means of production, marketing, and local conditions. These agencies articulated the concerns of ceramics workshops and resisted on the grounds that the administrative plan did not take into account the nature of the industry. Fonart representatives argued that the producers were diffuse, difficult to organize, and unaccustomed to oversight, and that they typically produced for the informal market, making any monitoring of statutes difficult.[7] In essence, the consensus among the working group was that the approach to enforcement advocated by the SSA was naïve and would not inspire compliance.

Resistance to the SSA's plan appears to have been well reasoned. Not only were the agencies correct in their assessment of the difficulty of contacting and organizing workshops (Samford 2012b), the inter-agency conversation brought to light the fact that there was no alternative low-temperature glaze that would function in traditional Mexican kilns. Thus, compliance would require the cessation of production, costly capital upgrades for roughly 10,000 workshops (SSA 2003), or the generation of a new technology by the workshops themselves. This latter feat was an impossibility given the information and technical expertise necessary to develop an alternate technology. A fourth possibility – assisting in the research necessary to find – or create – a low-temperature, lead-free alternative that would then require no capital upgrading and only a minimal amount of training to adopt – arose out of the interactions between Cofepris and agents of Fonart, the agency with the deepest expertise in ceramics producing communities.

2.4. Innovation phase

Rather than the need, justification, or consequences of regulation, this fourth option – assisting upgrading – centered on barriers to compliance, and it forced a re-opening of the collaborative space around lead oxide regulation. As the agency with the most extensive experience with ceramics producers, Fonart took the lead in this stage of the process. Although not a regulatory agency *per se*, this effort to promote innovation fit the stated mission of Fonart, which is to promote artisanal production. Fonart agents developed a "Strategic Plan" that was based on the idea that, although the use of lead oxide ran counter to health and social development and was increasingly problematic economically, immediate and rigid enforcement of the ban would be counterproductive.[8] Fonart's concern focused in large part on uncertainty about what alternatives were available to the workshops, along with the capacity of these family workshops to discover and adopt them.

Crucially, while Fonart did not have the technical expertise to develop an alternative glaze itself, it did have the capacity to find and coordinate experts who did. Fonart's approach, then, was to populate this regulatory space with a group of participants knowledgeable about some element of ceramic glazes and production and to coordinate their conversation around the development of an alternative technology. If "boundary management" – the controlled erosion of the barriers between areas of expertise in a firm's departments – is key to the generation of innovations

(Lester & Piore 2004), the process that Fonart set in motion was very much the same: it explicitly brought together people with different expertise to seek a solution to the technical problem exacerbated by health regulation, labor concerns, and broader economic policy. In this public space these participants worked to generate a solution that would meet both technical requirements and the cultural specifications of the ceramics producers.

General technical information was one of the first areas addressed under Fonart's program. The initial question was whether there was an existing glaze that required little or no modification to replace the lead oxide glaze, one that was free of toxic chemicals but would melt at the comparatively low temperatures reached by the kilns used in the thousands of workshops in question. Fonart agents contacted 84 glaze-producing firms worldwide requesting samples of lead-free glazes that fired at low temperatures, which were given to a team of chemists who worked in an advanced chemistry laboratory at the Autonomous Metropolitan University, Iztapalapa.

The role of the chemists was not only to fire and run laboratory experiments on potential glazes to determine if they fit the general specifications (i.e. a low melting point), but to determine their compatibility with the clay used by the major ceramics clusters in Mexico. As the chemists finished their analyses, they moved into more intensive conversation with the producers of ceramic glaze in Mexico (primarily Cerámicos San José and Macesa). The intention was to put the glaze-producing companies in the position of working with the glaze chemists (along with their own staff chemists) in order to use the outcomes of the extensive tests to generate a domestically produced glaze based on those that met the necessary specifications. The glaze producing firms were loath to bear the full cost of developing glazes and field testing when the commercial prospects for a new product were uncertain; it was unclear how much investment would be necessary to generate a glaze flexible enough to function in a wide variety of settings and regulations might ultimately go unenforced, or an increasing number of ceramics producers might be driven from business, making it impossible to recoup research and development costs. Beyond bridging the communication gap between the glaze producing firms and the ceramics workshops, the coordination and participation of Fonart helped both lower the costs of developing the new glaze and also the perceived risks.

While the glaze chemists and the glaze producers brought together by Fonart were able to generate a lead-free glaze that fires at low temperatures, a gulf still existed between the experience of firing ceramics in a laboratory setting and firing them in workshops. A variety of factors introduced at the workshop level – method of mixing, varied quality of fuel, temperature variation – departed from the ideal conditions under which the lead-free glaze was developed and tested. Recognizing that the results with the new glaze might not be replicable because of these variations, Fonart developed a practice of mediating communication exchange between the glaze producers and the workshops in which the lead-free glaze would be put to use. For workshops, organizing and communicating was costly, as was field-testing for the glaze producers. Fonart adopted the practice of sending field technicians – agents partially familiar with local production and with the new glaze – to ceramics producing communities, where the technician would observe workshops testing the glaze *in situ*. Workshops that participated in these field trials provided critical information about the performance and appearance of the new glaze, ideas about the barriers they faced, and how to improve glaze adoption. With this information, manufacturers could make incremental adjustments to improve the new glaze's suitability. This iterative process effectively brought together the expertise of the glaze manufacturers and the scattered ceramics workshops, thereby generating a means by which the glaze could be fine-tuned through consultation and trial. This cross-sectoral cooperation would not have taken place without Fonart's active coordination and encouragement of multidirectional information exchange.

In sum, this extended period of conversation within the regulatory process allowed for the generation of an innovative technology that by all accounts would not have been developed in the absence of Fonart's efforts to provide a collaborative public space. Given the productive structure of the industry, the capacities of the workshops, and the uncertainties faced by glaze producers, the necessary glaze innovations would not have occurred without this process. As the need for restricting lead in ceramics production was clear-cut, the interpretive process centered on *how* workshops would become compliant, rather than on what compliance would look like. Ensuring that compliance through upgrading (rather than attrition) was even possible required a long period of interpretation and the government engagement of the industries being regulated. As part of the regulatory process, this interpretive period provided the possibility of an innovation that has allowed upgrading in ceramics workshops.

2.5. Enforcement

Although the actual enforcement of norms against the use of lead oxide is beyond the scope of this discussion of the role of interpretive public space, the form that enforcement has taken was strongly affected by the conversation regarding the prohibitions. Specifically, Cofepris accepted the notion that promoting training with the new technology would be necessary before undertaking more punitive steps toward enforcement. Addressing the lack of access to information about the use of the new glaze became the primary objective, without which it was unreasonable to expect adoption of the new technology in response to emerging regulation. In Gunningham and Sinclair's (1999) terms, the policy mix needed for enforcement required not only elements of command and control regulations and informational campaigns, but also the assistance with innovation described above.

3. Regulatory collaborative space in other contexts

Little scholarship has explicitly taken up Lester and Piore's (2004) claim about the potential for the generation of innovations within the regulatory process. The case presented here illustrates several key features of this process that are likely to be broadly applicable. First, the very involvement of regulatory agencies indicates an existing sense that upgrading or innovation needs to occur within an industry, although this may not be well developed. There may be concerns with meeting existing or emergent domestic social regulation (environmental or labor laws), meeting external product or process standards, or a combination of the two. Second, the outcome of the regulatory process is uncertain, and, consequently, the process is necessarily flexible and ad hoc in method. Developmental issues are often sequentially revealed (see Sabel & Reddy 2007), so the addition of new participants, the changing of tack, even the redefinition of the regulation during a statutory period, or the proposed manner in which enforcement will occur are likely to be an inherent part of the process. Third, the process involves a significant amount of learning and information sharing that occurs both within and between the public and private sectors. The private enterprises to be regulated are involved as the ultimate adopter of the innovations, but regulatory or public agencies may provide coordination, related industries may provide information about inputs or related products, and research universities and institutes may provide expertise. Two factors heightened the imperative for collaboration in this case (and likely in similar cases): (i) the lack of expertise in the regulated sector necessary to make the upgrades and to thus become compliant with new regulations; and (ii) the possibility that the regulations in question are a response to the requirements of foreign markets, a situation in which regulatory agents themselves may not fully understand how to promote compliance (see Dubash & Morgan 2012). Fourth, where they did well, the public agencies were able to use discretion to adapt the regulatory strategy to the nature of the industry and its individual enterprises, as well as to the agencies' own capacities, including, in this case, a fundamental lack of knowledge about the productive technologies they were charged with regulating. Finally, the process is sheltered from market pressures in the sense that the particular private enterprises are protected from bearing (most of) the costs of the innovation. Costs may be shouldered by regulatory agencies, other parts of the public sector, public universities, or dispersed among enterprises via organized industry groups.

Instances of fundamentally similar collaborative public spaces in the regulatory process appear to be responsible for productive innovations in the developing countries more frequently than has been previously acknowledged. While not framed around the concept of collaborative space in the regulatory process or explicitly concerned with the above characteristics of those spaces, a number of recent studies describe similar dynamics in cases that led to upgrades as a consequence. I briefly review several of these studies, drawing attention to the elements that are germane in this context.

In a larger discussion of labor standards promoted by market integration, Schrank (2013b) describes how the Ministry of Labor (OIT) in the Dominican Republic used an "integrated approach" to overcoming the knotted issue of child labor law enforcement in rural areas. This is a multifaceted problem in which the short-term demand for low-skill agricultural labor results in the use of young children in fields, school attrition, and low skill development, and the eventual generational replication of the same working and living conditions. As with other producers described in this paper, strictly punitive measures were unlikely to be effective, given the short-term market pressures and informational faced by the producers. Recognizing this, the OIT sought to assist farmers in upgrading to production that would be inherently incompatible with the use of child labor. It coordinated the participation of schools and NGOs to reduce the actual costs of attending schools by feeding children and providing supplies, as well

as public agencies – the Agrarian Bank (Banco Agrícola), microfinance agencies, and the technical training agency National Institute of Vocational Training (El Instituto Nacional de Formación Técnico Profesional, INFOTEP) – that helped decrease the opportunity cost of child labor by promoting the production of non-traditional crops; these crops were both more lucrative in export markets and less conducive to the use of unskilled child labor (i.e. required more highly skilled picking and sorting). However, because of the informational and financial hurdles, small Dominican farmers would have been unable to upgrade and become compliant with child labor law without this collaborative effort.

In a study that similarly deals with externally originating standards, Aparicio *et al.* (2008) outline a collaborative effort to help Argentine citrus producers innovate production and raise product quality to meet European Union phytosanitary regulations. The citrus growers were largely unable to undertake the expense of upgrading to meet these regulations on their own, given capital and informational requirements. Instead, an array of other actors became involved in developing training courses and disseminating information necessary for the producers to meet these regulatory norms. These institutions included the government agency responsible for the regulation and official certification of agricultural exports (SENASA) and the network of producers belonging to the industry-wide Association of Citrus Producers. The effort also included a private research center, the Obispo Colombres Center, whose role was to help facilitate the spread of improved agricultural practices by testing and monitoring soil and chemical use. The consequent upgrades to citrus production have required more controlled use of chemical agents, along with improved environmental and labor practices. Although some growers have been excluded, the process described by Aparicio *et al.* (2008) is clearly an effort that was driven by regulation (albeit external), relied upon cross-organizational collaboration, and was undertaken in a manner that sheltered the citrus producers from competitive pressures among themselves.

Finally, Amengual (2013) argues that a similar collaborative effort was set in motion to effectively regulate toxic effluent from sugar processing in Argentina. After years of ineffective regulation, sugar processers in the province of Tucumán faced social outcry about their failure to meet environmental standards. Scrutiny from NGOs and environmental groups heightened the incentives for regulatory agencies to enforce regulations that existed on paper. In spite of the emergent regulatory pressure, most firms had little expertise in the area and did not know how to comply with wastewater regulation. The provincial government, therefore, established a series of programs that drew on expertise from local government, federal agencies, and the provincial university; these provided advice and assistance to processers and especially sought to identify technological "win-wins" that would reduce pollution and cut costs or locate other functional efficiencies in production. Civil environmental groups – not wholly sold on programs that allowed producers to escape regulatory sanctions for a time – participated both by strengthening the capacity of the enforcement agency *and* by continuing to act as independent monitors, organizers, and providers of information. In sum, Amengual (2013) describes a collaborative effort within the regulatory sphere that ultimately resulted in an almost universal filtering of sugar production wastewater in the province, a consequence of the collaborative efforts of firms, the regulatory agency, outside experts, and civil society groups.

None of these studies frame a case of innovation and technological upgrading explicitly as an outcome of collaborative regulatory space. In each, domestic or international regulations highlight shortcomings of existing processes or products, but rather than stepping back to require enterprises to innovate on their own, government agents help establish spaces in which existing organizational, sectoral, and disciplinary barriers are breached and possible solutions are proposed and deliberated. Within these government-sponsored fora, solutions to regulatory shortcomings are worked through while the private sector participants are sheltered from competitive pressures between themselves.

4. Conclusions

This paper draws together literature on regulation and innovation, two areas of study that have to date been treated independently. A series of cases demonstrate that what Lester and Piore (2004) call public collaborative or "interpretive" space may be responsible for important innovations in both the developing and the developed world, and that this dynamic does not seem particularly uncommon, especially when the targets of regulation are relatively non-innovative. This point is a necessary addendum to the observation that these public spaces have frequently been established or sponsored by large, advanced firms or by the state through universities (Lester & Piore 2004),

governmental or semi-governmental institutions (Breznitz 2005; Fuchs 2010; Weiss 2014), and broader cooperative systems (e.g. Nelson 1993). Poorer countries lag in both large, advanced firms and government capacity and the financial wherewithal to maintain these innovative spaces; however, they do seem be able to use the regulatory sphere in this manner, and this can have important developmental and distributional consequences.

Innovation within the regulatory process seems a particularly well-suited policy instrument for promoting compliance in lower-tech enterprises in the developing world. For many such enterprises, a fundamental issue is a lack of information about the shortcomings of existing technologies and the potential for upgrading. This was clearly true of the ceramics producers in Mexico who did not understand the long-term health effects of lead oxide, but also of producers in other small industries, including small-scale brickmakers (Blackman 2006a), leather tanners (Blackman 2006b) and agricultural producers (Aparicio *et al.* 2008; Amengual 2013; Schrank 2013b). Moreover, these gaps are exacerbated by the fact that developing countries face pressures from a variety of international sources (e.g. international organizations or trade agreements) to adopt particular environmental, labor, and other social regulations, regardless of their domestic industries' capacity to comply. In this dynamic, regulatory agencies themselves assume part of the onus to address outdated technologies, dangerous practices, and low-quality production. And the sheltered collaboration aimed at achieving this upgrading allows interested parties to tease out the barriers to upgrading, address knotted or sequential barriers, propose and test solutions without risk, and, thus, facilitate the meeting of standards that would be unmet by the private sector alone.

The scholarship on regulatory "policy mixes" argues that the options available for promoting compliance with regulations should be thought of as potentially complementary, rather than as exclusive alternatives (Gunningham & Sinclair 1999). The opening of space for innovation may be thought of as another policy choice, more active than a basic informational campaign and less prescriptive than command and control instruments. What is clear from the cases presented here is that simple information campaigns, many kinds of economic incentives, or punitive command and control instruments alone were insufficient. That said, assistance with innovation in a collaborative public space was not the only regulatory instrument employed in these cases. The regulation of lead use in Mexico, for example, also included an informational effort to diffuse the new technology, and, ultimately, the statutes barring lead-oxide use allow for punitive consequences for noncompliance. Hence, collaborative efforts at innovation for compliance may complement other policy instruments, as they address distinct kinds of gaps in process and product technologies that other instruments may not. Further research may help clarify and generalize the relationship between these collaborative spaces for innovation and existing notions of combinations of regulatory instruments (Gunningham & Sinclair 1999).

As an approach to innovation policy, targeting industry through the regulatory system may not generate sequential upgrading, as fuller national innovation systems might, but there are clear advantages. First, even though they are made under the auspices of the social regulation, these innovations have the potential to improve the quality of products, not only the labor and environmental conditions under which they are produced (see Schrank 2013a). Second, as they are, by definition, carefully targeted at particular sectors, these interventions are likely to be inexpensive and can draw on existing expertise. In any case, most developing countries have not established effective, sustained national systems for developing innovations. Third, these kinds of interventions are especially useful in developing countries, where workers are predominantly employed in small enterprises or self-employed and are relatively low-tech. As "low-hanging fruit," the technical requirements inherent to upgrading in simple industries and agricultural production are often not great and may require only local adaptation of existing ideas and technologies. Yet because of the numbers of people employed in small or family-run, low-tech enterprises, the consequences for labor and health conditions and local environment are potentially great.

Although Mexico stands out in this respect (Zepeda *et al.* 2009), many developing countries have struggled to develop coherent industrial policies that promote innovation and upgrading – particularly among small and micro enterprises – in the wake of market liberalization and deregulation that took place in the 1980s and 90s. This study speaks to that absence in two ways. First, in spite of the generally gloomy outlook for small, low-tech firms exposed to market pressures and increasing standards and regulation, it demonstrates one mechanism by which innovation and upgrading can be encouraged. There is a long line of development literature that underlines the critical importance of combining public and private sector capabilities for small-scale development projects (among others, Evans 1997, Ostrom 1997, Tendler 1997); the cases discussed here demonstrate flexibility in finding the sources of those capabilities. Second, even in the absence of a coherent set of industrial policies and institutions to promote

upgrading, positive incremental steps may be made through flexible regulatory agencies that work to carve out and help manage spaces in which innovation can occur. While this may not fully compensate for broader developmental policies, in particular sectors it may help mitigate some of the short-term pressures associated with increased market integration and provide a pathway for the enterprises in these sectors to adopt "high-road" solutions.

While studies of regulation have recently made much progress in understanding regulatory discretion – particularly how it emerges and how it is managed (e.g. Pires 2011) – to date there has been little explicit attention paid to how that regulatory discretion is related to the industries' innovative capacities; the lack of a common conceptual frame has impeded the development of a more coherent discussion of its role in upgrading production in the developing world. As this paper demonstrates, there are a number of recent – but otherwise focused – studies that, like the example of the Mexican ceramics sector, illustrate the role that the regulatory process and discretionary agents can and often *do* play in productive upgrading. While the details of these particular collaborative processes are distinct, there is both potential academic and policy benefit in better understanding broadly how they operate and where they develop. I have outlined some of the general characteristics for these spaces in order to illustrate their commonalities. But along with refining this concept, a number of other salient issues will need to be addressed: Are these collaborative spaces more common in some sectors than in others? Does the organizational strength of private enterprises play a role in determining where they appear (Samford 2012a)? How do social factors shape collaboration (Schrank 2008)? How might these regulatory spaces differ when large or more technologically advanced sectors are the targets of regulation? The first step taken here is to point out that these episodes have been occurring in developing countries and that a more coherent conception of what these episodes are cases of – collaborative public spaces – will further help uncover the developmental value of these regulatory dynamics.

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Notes

1 In the area of environmental regulation particularly, Holley *et al.* (2012) identify a similar degree of state-society collaboration in what they call the "new environmental governance." While their concern is in part with the devolution of governance and regulation to subnational levels, which is less germane in the context of the cases discussed in this paper, they also stress collaborative multiparty deliberation to design and implement effective regulations.

2 I make no claim that all comparable episodes will involve the same actors or dynamics; in fact, beyond the use of market-sheltered collaboration between public sector and private agents with the aim of generating innovations and upgrading to meet process, product, labor, or environmental norms, cases can reasonably be expected to differ in detail.

3 This is not to suggest that all small enterprises are non-innovative. A long literature of industrial clusters in Italy, for example, demonstrates that upgrading is clearly within the reach of some; however, generally speaking, small, low-tech firms do frequently face higher barriers to the adoption and development of new technologies than do larger, more advanced firms (Von Tunzelman & Acha 2005).

4 For example, 95.5 percent of all enterprises in Mexico have fewer than 10 workers. While there may be concern that the artisanal producers discussed here have motivations that are distinct from other small enterprises, there is a good deal of evidence that artisanal producers behave much like other kinds of enterprises. Chibnik (2000) finds artisans adapting production to market demands: specializing and even developing new products. Samford (2012b) similarly finds both qualitative and quantitative evidence that decisions about upgrading are largely based on economic concerns, the viability of their production methods, and the structure of the market for their products. While it may be true that the ceramics producers in this study are particularly risk averse and disinclined toward investment in R&D, this distinguishes them in degree from other small enterprises rather than in type.

5 An undetermined (but reportedly large) amount of documentation surrounding the process described here was destroyed when the federal government changed hands in 2000 and PAN (Partido Acción Nacional)-appointed directors replaced the PRI (Partido Revolucionario Nacional)-appointed directors of Fonart. The national director of Fonart's Lead Substitution program was not removed and provided invaluable information about the regulatory process.
6 Among the most prominent agencies were the National Fund for the Advancement of Artisan Production (Fonart), Mexican Association of Popular Art and Culture (Amacup), National Commission for the Development of Indigenous Peoples (CDI, formerly INI), and artisans organizations from states such as Puebla, Michoacán, Jalisco, and Estado de Mexico (Fonart 2010).
7 Personal interview with M Covarrubias, Director of National Program for the Adoption of Lead-Free Glazes, Mexico City, 5 July 2011.
8 This is the position that Cofepris eventually took as well: rigid punitive enforcement would ruin the workshops they would be able to monitor. In its later agreements with Fonart, Cofepris has adhered to a more "tutorial" approach to compliance, allowing Fonart to train producers into compliance, rather than forcing workshops into compliance or out of business by means of seizures, fines, and the like (see Schrank & Piore 2007 for discussion of tutorial approach to regulation; Samford 2012b for dynamics of technology diffusion).

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