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Conceptualizing the Regulatory Impact of Disruptive Innovation: Compression and Legacy in Professional Ecologies

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Abstract:

There is increased interest in analyzing markets as organized phenomena, and one iteration of market organization can be observed in the mutual impact of innovation and regulation. In particular, this paper is interested in the impact of innovations on regulatory capacity and process. This reverses the causal arrow generally assumed in the literature that deals with how regulators can organize markets in order to either support or foster innovation. The key analytical distinction of this paper is the assumption that a particular kind of innovation, disruptive innovation, may unexpectedly and dramatically alter existing markets or create new ones with important political consequences. This disruption typically leaves regulators woefully unprepared to organize the new or altered markets, especially in the cases where their actions are shaped by institutional, intellectual and relational legacy. This difficulty is compounded by the fact that disruptions typically cause markets to increase the rate of change, i.e. temporal compression. The policy problems that thus arise have to be solved by paying attention to the collision between compression and legacy.

This paper reviews the literature on the political economy of regulation, and argues that increased attention to the roles of professions and time can bring greater analytical strength to the study of innovation. The first part of the article reviews the literature on regulation, identifies some of its assumptions and clarifies how it deals with the concept of innovation. The second part of the article explains what is meant by disruptive innovations and how the current literature is ill equipped to investigate their regulatory impact. The third and final part of the article proposes a theoretical framework that is suited to redress some of the shortcomings identified by drawing on the ideas of linked ecologies and time horizons.

KEY WORDS: Linked ecologies, time horizons, disruptive innovation, regulation

Introduction

Unexpected and dramatic market changes cause headaches for agencies that are increasingly called upon to regulate complex, fast-moving, transnational and highly technical sectors of the economy. The 2008 financial crisis is testament to this fact, but it can be argued that a population of topical cases exhibit the same characteristics. Consider the heated arguments about hydraulic fracturing ('fracking') for shale gas, e-cigarettes, or digital piracy in the European Union, the United States, and elsewhere. Innovations such as these present thorny policy problems to regulators who are expected to balance competing demands on issues they may not fully understand. These policy problems are further complicated when innovations dramatically increase the rate of change in the regulated markets. This temporal compression leaves regulators in the position of paying ever greater attention to fine-grained detail in rapidly evolving markets, while working within the constraints placed upon them by institutional legacy.

This issue is understudied, and therefore the purpose of this paper is to make the case for why increased attention to the roles of professions and time would bring greater analytical strength to the study of regulation when engaging with innovations such as those mentioned above. The first part of the article reviews the literature on regulation, identifies some of its assumptions and clarifies how it deals with the concept of innovation. The second part of the article explains what is meant by disruptive innovations and how the current literature is ill-equipped to investigate their regulatory impact. The third and final part of the article proposes a theoretical framework that is suited to redress some of the shortcomings identified by drawing on the ideas of linked ecologies and time horizons.

Reviewing the literature on regulation

The literature on regulation owes much to the academic tradition that developed from the notion of the 'regulatory state'. Exact definitions of the regulatory state are difficult to come by. Levi-Faur (2013: 39)

suggests that “the regulatory state is a state that applies and extends rule making, rule monitoring, and rule enforcement either directly or indirectly [and] the regulatory state claims a legitimate monopoly on the deployment and distribution of power through rule making, rule monitoring, and rule enforcement.” The origins of the term ‘regulatory state’ go back to Anderson’s book *The Emergence of the Regulatory State* (1962), but it was not until Seidman & Gilmour (1986) reflected on the differences between welfare states and regulatory states that the term approached its current meaning. Seidman & Gilmour used the notion of the regulatory state to make sense of privatization and outsourcing under the Reagan administration. This theme was carried forward by Majone (1994, 1997), who developed the theory extensively and adapted it to a European context.

Majone was interested in explaining the rise of the regulatory state in Europe. States are generally thought to engage in three different types of intervention in economies: income redistribution, macroeconomic stabilization, and market regulation (Majone 1997: 140-141). The relative importance of these functions has changed over time. In the aftermath of World War II, the Keynesian welfare state engaged heavily in redistribution and macroeconomic management in order to play a central role in rebuilding economies. In the 1970’s and 80’s, neoliberal market enthusiasm took over, and states started engaging in bouts of privatization, liberalization and deregulation. This story has often been described as a ‘dismantling’ of the state, but it is more accurately described as a redefinition of the functions of the state. The redistributive and macroeconomic functions of the state lost relative importance to the function of market regulation. Paradoxically, deregulation at the state level was frequently associated with the establishment of new regulatory agencies that operate at a different governance level. Thus, it is more appropriate to speak of ‘re-regulation’ than ‘de-regulation’. These are the developments that gave birth to the regulatory state.

What caused the rise of the regulatory agency? Regulation is defined as “sustained and focused control exercised by a public agency over activities that are socially valued” (Selznick 1985). Sustained and focused

control over economic sectors require expert knowledge of the sector as well as intimate involvement with its activities. These prerogatives provide specialized regulatory agencies a comparative advantage in the practice of regulation as opposed to the traditional, Weberian bureaucracy (Majone 1997). Traditional bureaucracy is characterized by generalist knowledge, centralization and hierarchy. These traits make them well-suited to carrying out the redistributive tasks of the welfare state, but ill-suited to market regulation. Market regulation often requires in-depth scientific, engineering or economic knowledge, which can be recruited to specialized and narrowly-focused agencies. In addition, placing these agencies at arm's length from government provides them with independence from political machinations that allows them to pursue regulation that will be effective in the long-term and cements their legitimacy as stemming from their expertise in the subject matter.

The increasing importance of the regulatory agency led authors to begin shifting their focus from the regulatory state to regulatory governance. In part, this shift was synonymous with the general shift in the political sciences of moving from a focus on centralized government to decentralized governance, but for regulation scholars it was crystallized in the notion of the "new regulatory state" (Braithwaite 2000). What sets the new regulatory state apart from the old one is its reliance on forms of self-regulation: compliance systems, codes of practice, standards, etc. This in turn brought scholars to recognize new forms of private power in business or civil society actors (Braithwaite & Drahos 2000), further shifting the focus from the regulatory state to regulatory governance. What this new body of literature was challenging was the assumption that the state was necessarily central to regulatory governance (Scott 2004). In the "age of governance", the capacities and resources to govern have become dispersed.

The dispersal of governance coupled with the globalization of firms and markets led many to talk of a "new world order" or "the retreat of the state". However, these narratives miss the fact that states are as active as ever, but are simply working in new ways (Mazzucato 2013, Moran 2003). Levi-Faur (2005) picked up on the links between the neoliberal agenda, regulatory governance and the globalization of regulation in the term

'regulatory capitalism'. He characterizes regulatory capitalism as composed of "(1) a new division of labor between state and society (for example, privatization), (2) an increase in delegation (remaking the boundaries between the experts and the politicians), (3) proliferation of new technologies of regulation, (4) formalization of inter-institutional and intra-institutional relations and the proliferation of mechanisms of self-regulation in the shadow of the state, and (5) the growth in the influence of experts in general and of international networks of experts in particular" (Levi-Faur 2005: 27). He argues that by focusing on the neoliberal revolution, we have missed the corresponding regulatory revolution. Privatization and deregulation was empirically accompanied by an explosion in the number of regulatory agencies as well as more regulation within and between companies, states, and civil society actors.

The explosion of regulatory agencies has been documented by Jordana, Levi-Faur and Fernández-i-Marín (2011). Studying a data set comprised of 48 countries and 15 sectors for the period 1966-2007, they provide empirical proof of the rise and diffusion of regulatory agencies across industrialized countries, and segment the process into three different stages: the incubation period (1966-88), the takeoff period (1989-2002), and the saturation period (2002-2007). By studying diffusion, they are interested not only in documenting the growth of the regulatory state, but also in explaining whether the decision by a government to establish a regulatory agency is primarily influenced by national or sectoral pressures. According to their findings, the establishment of regulatory agencies over time follows an s-shaped curve starting with a few experimental ones at first, followed by a rapid surge as their comparative advantage is recognized and copied across economies, until saturation sets in and most relevant economic sectors have been brought under administrative regulation. In the first stage, both national and sectoral pressures are important, but in the later stages, the sectoral diffusion channel is dominant. All of this goes to suggest "the increasing importance of social networks of professionals, regulocrats, and epistemic communities that are active in international organizations or also share similar cultural identities, alongside the increasing embeddedness of the national in the global and the global in the

national" (Jordana, Levi-Faur & Fernández-i-Marín 2011: 1362). The importance of sectoral diffusion over national diffusion behooves us to shift our lenses from the national or international to the transnational.

The above conclusion sits well with the body of literature that is bringing together the strands of transnational governance and transnational regulation, such as Mattli and Woods (2009), Abbott and Snidal (2009a, 2009b), Djelic and Quack (2010), and Overdevest and Zeitlin (2012). However, what the above studies only touch lightly on is the central role of professions in regulatory capitalism. Professionalism and expertise has already been highlighted as an important source of legitimacy for regulatory agencies, and thus the political conflicts that play out under their auspices are bound to be affected by matters of professional jurisdiction, affiliation, and knowledge. Furthermore, as professionalism grows in importance, the traits of regulators, their career incentives, and their positions in multiple overlapping networks present a radical qualitative change to the institutional DNA of the traditional bureaucracy – points that Majone already pointed to in 1997, but that have not been adequately addressed yet. An emerging body of literature is beginning to orient itself towards tackling these questions (see Seabrooke 2014, Faulconbridge & Muzio 2012, Baker 2013, Quack 2010, Chwieroth 2007).

Up to this point I have provided a brief overview of the literature on regulation and clarified why it inevitably brings us to a focus on the role of professions in the age of regulatory capitalism. A remaining question is how the theme of innovation is dealt with in the regulation literature? Space constrains me from exploring this question extensively, but some key insights may be drawn. Innovation is defined as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (Rogers 2003: 12). In the regulation literature, innovation has been dealt with in two ways: either as innovations that occur within the political system which allow for a better way of carrying out the functions of political actors, or as desirable exogenous market phenomena. Beginning with the former, the main interest for regulation scholars has been in studying the diffusion of political innovations across societies (see for example: Berry & Berry 1990, 1992; Jordana &

Levi-Faur 2005; Jordana, Levi-Faur & Fernández-i-Marín 2011). The latter way of dealing with innovation (as market phenomena) typically study how regulation may contribute to or hinder innovation in the markets (see for example: Mazzucato 2013; Porter & Van der Linde 1995; Cooke, Boekholt & Tödtling 2000), and how this relates to 'institutional competitiveness' (Campbell & Pedersen 2007). Market innovation is of topical interest to policymakers in recent years due to their capacity to deliver economic growth and jobs in industrial societies (Lipsey et al. 2005).

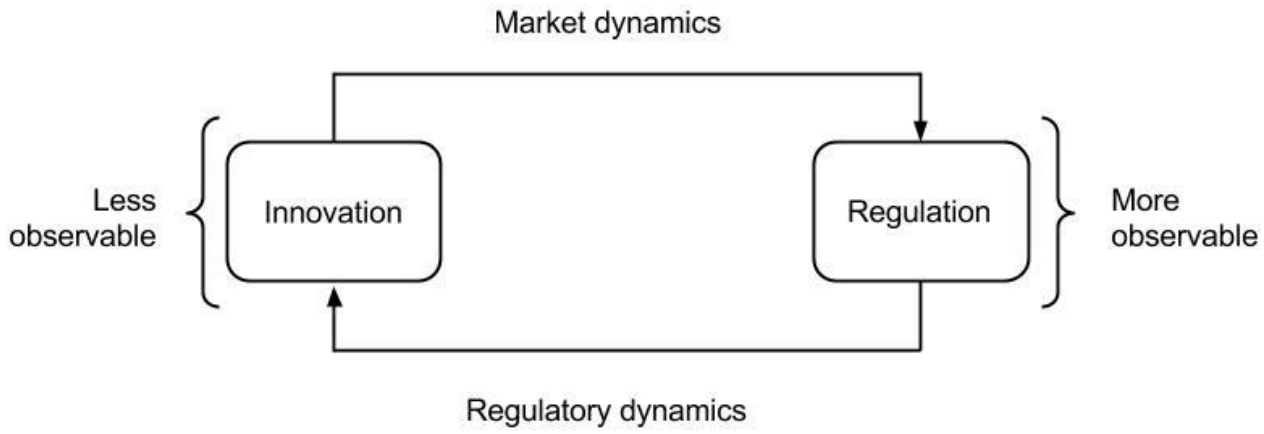
What both of these approaches refrain from is a questioning of the impact that market innovations themselves may have on the policymaking process. Majone points to Chandler when ascertaining that "structure follows strategy and that the most complex type of structure is the result of the concatenation of several basic strategies" (1997: 139). Based on this assumption, the rise of the regulatory state was due to the concatenation of privatization, deregulation, and liberalization. The novel question that I ask here is how different types of market innovations themselves impact the structure of regulatory capitalism? The key analytic distinction is that this question reverses the causal arrow posited by most regulation scholars that deal with innovation. Rather than examining how regulators can further or hinder innovation in the markets, the point is to study how significant market changes, as brought about by innovation, impacts the regulatory structure and process.

While the co-constitution of state and market is a widely accepted notion, political economists generally take their analytical starting point in the state and work towards markets from there. This is partly due to habit and intellectual heritage, and it is partly due to issues of observability. Features of the political landscape such as laws, regulation, institutions and policies are easier to identify and observe than features of complex and fast-moving markets. This is especially true when considering the theoretical and methodological tools political economists have at hand. Furthermore, it is easier to declare victors and losers in political outcomes than in market outcomes. The preferential treatment thus accorded to states has painted a picture of market dynamics as secondary and responding to regulatory dynamics, while regulators are largely shielded from the turbulence

of markets. Market impact on regulation, in this traditional approach, takes the form of lobbying and responding to regulation (Woll 2008). By taking my analytical starting point in the market, I wish to make the point that market dynamics can themselves impact on regulatory dynamics. Lobbying would not be an example of this. Rather, sudden and dramatic market changes can automatically demand a regulatory response without any explicit involvement of lobbyists. Figure 1 below illustrates the distinction between the two causal arrows.

The following sections of the paper will attempt to identify the theoretical and methodological positions that are best suited to this project of making the impact of innovation on regulation observable and salient. As I progress through the following sections, I will make returns to the literature discussed above in order to determine whether there are insights here that can be repurposed towards the new end.

Figure 1: The co-constitution of innovation and regulation



The regulatory impact of disruptive innovation

If regulation entails sustained and focused control over activities that are socially valued, such as market activity, innovations that severely upset or change the status quo of a market will have a significant regulatory

impact. These types of innovations have been identified in the management literature as 'disruptive innovations' (Christensen & Raynor 2003), although this concept traces its intellectual heritage to Schumpeter (1942) and 'creative destruction'. Originally conceived in terms of 'disruptive technologies' (Bower & Christensen 1995; Christensen 1997), disruptive innovations are innovations that significantly improve a product or service in unexpected ways, thereby creating new markets or disrupting existing ones. They can be both tangible (such as a new product or technology) and intangible (such as a new service or business model) (Christensen & Raynor 2003). Current examples include e-cigarettes (disrupting the tobacco industry), hydraulic fracturing for shale gas (disrupting the natural gas and energy industry), and digital streams and torrents (disrupting the audio-visual entertainment industries).

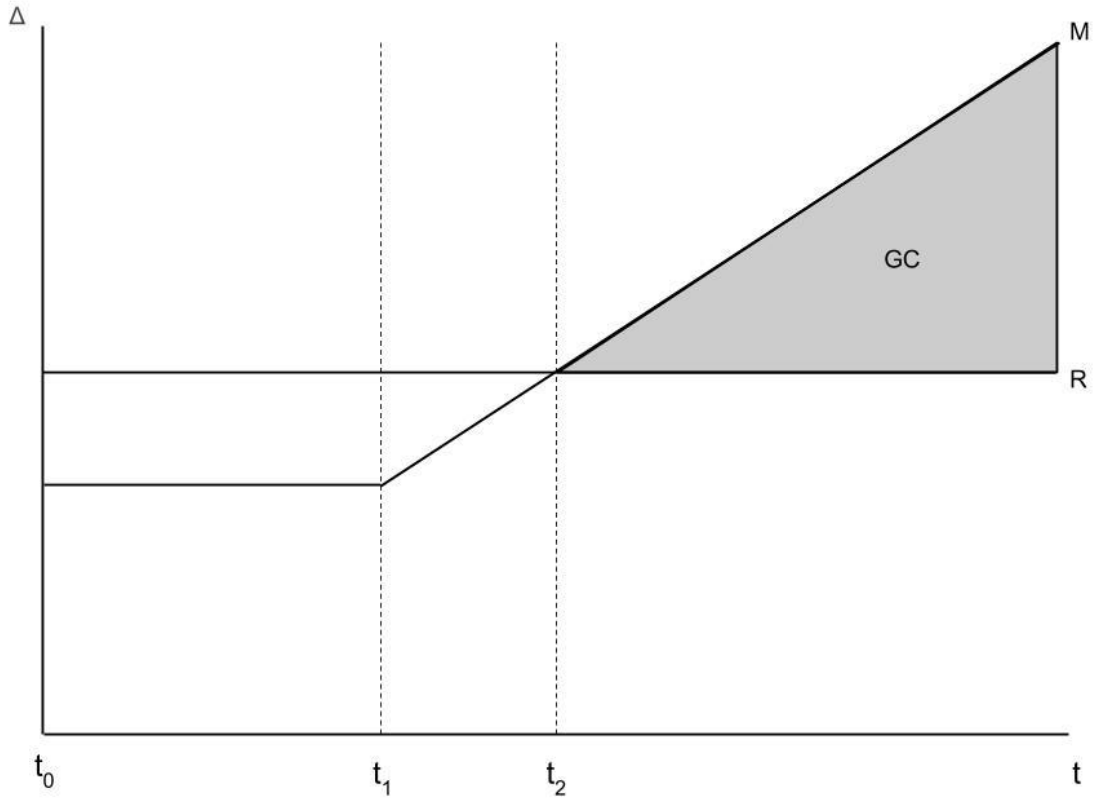
Disruptive innovations are frequently technical, complex, fast-moving and transnational. Examining these characteristics from the perspective of market participants yields the following insights. By technical it is meant that the innovation relies on business models that are built around a new technology, and that the utilization of this technology is reliant on specialized professionals that possess the relevant expertise. Complexity denotes the inherent uncertainty of disruptive innovations, due to the unexpected outcomes and impacts of the innovation on numerous actors and markets (including *unexpected* actors and markets). The fast-moving nature of disruptive innovations has to do with the speed at which new markets are created and old ones disrupted. There is a time lag between the occurrence of the disruption and the adjustment of competitors and customers alike. Finally, disruptive innovations are often transnational phenomena, in the sense that their impacts tend to ignore state boundaries.

The characteristics of disruptive innovations defined above (technical, complex, fast-moving and transnational) make them incredibly difficult objects of governance. As we shift perspective from market participants to market regulators, there are different consequences of the four characteristics. The technical expertise to understand and regulate complicated technological innovations is often missing from the regulatory agencies.

The complexity of disruptive innovations means that regulation can be inadequate in the sense that it does not reach or capture all the relevant actors and sectors that have been unexpectedly impacted, directly or through various externalities. The fast-moving nature of the innovations means that market dynamics can outpace regulatory dynamics – or in other words, the market evolves too fast for regulation to keep up. Finally, being transnational phenomena, regulating disruptive innovations can be difficult or impossible to achieve by any single state working unilaterally.

Building on these characteristics of disruptive innovation, an ideal-typical governance impact may be imagined as depicted in Figure 2 below. It is an 'ideal type' – it depicts a theoretical abstraction derived from empirical

Figure 2: An ideal-typical governance impact of a disruptive innovation



observation, but fictional in the sense that it does not (and should not) completely and accurately reproduce a real-world phenomenon (Weber, 1949).[1] However, it is a construct that we can use to further our understanding of disruptive innovation. The x-axis measures the passing of time (t) while the y-axis measures the rate of change (Δ). The rate of change can be measured both in the market (M) and in the regulatory capacity (R) to oversee that market. From t_0 to t_1, the market is in a state of equilibrium and is exhibiting a constant rate of change corresponding to the normal evolution of a market. The regulatory capacity during this stage is greater than the rate of change in the market, posing no difficulties for regulators to monitor the market and ensure it is well-functioning. This is in other words the status quo of a mature market with settled institutional arrangements.

At t_1, the market experiences a disruptive innovation. This greatly increases the rate of change in the market. At t_2, the rate of change in the market surpasses the capacity of regulators to keep up. This gap increases over time as long as the regulators are unable to adjust regulatory dynamics to the new market realities, creating a swiftly growing regulatory deficit or governance crisis (GC). Over time, regulators may come to understand the new market dynamics and introduce satisfactory regulation, thereby increasing the rate of change in regulatory capacity in order to address the governance crisis and eliminate the regulatory deficit. Alternatively, regulators may reorganize themselves or draw on new networks of expertise to achieve the same result. Other responses can be envisaged as well, but the lag between a disruptive innovation and the regulatory response will introduce a period of governance crisis.

Seen in this way, disruptive innovations can be thought of as events that punctuate an equilibrium (Pierson 2004). This equilibrium is not necessarily understood in the economic sense of optimally functioning markets, but in the sense that these are mature markets that have been functioning according to relatively settled

[1] Indeed, ideal types are "meant to be broken" (Seabrooke 2007). They are methodological utopias to be held up and compared to empirical observation in order to highlight variation.

dynamics: the technologies at play in the market are old or well-understood, the players know each other well, and relations, regulation and competitive pressures are stable. All of this implies strong institutional embeddedness (Polanyi 1944; Blyth 2002) and a low, constant rate of change. A disruptive innovation upsets this equilibrium in many different ways: it may introduce new technology that regulators do not understand, it may introduce new players, it may strain or upset existing relations, current regulation may be inadequate, and competitive pressures can rise. This discussion implies that equilibria, understood in the sense of relatively settled market and regulatory dynamics, can be upset via disruptive innovations not only through economic or institutional channels, which are important (Pierson 2004), but also through sociological ones. For example, by introducing new players or creating and rupturing network ties, changes in status (Podolny 2005) and the field of positions (Bourdieu 1984) will significantly impact the policy arena. Relationships between regulators and the regulated are important in shaping the regulatory process (Woll 2008). The sociological channel is therefore crucial when examining the impact of innovation on regulatory capitalism, and the key to unlocking this channel lies in considering the importance of time. Disruptive innovation causes dramatic shifts in the ways actors perceive the importance and relevance of past and future time. In other words, disruptive innovation causes shifts in time horizons and collisions of different time horizons that different policy actors hold. These collisions and the interplay between temporal compression and legacy should be front and center when studying the regulatory impact of disruptive innovation.

The importance of time and how to study it

To return briefly to the extant literature on regulation covered above, how do the scholars deal with the dimension of time in their studies, and is there anything that can be appropriated for the current analysis? The studies of innovation diffusion cited above deal with a perceived “compression of space and time that turns countries and sectors that were isolated into interconnected and interdependent entities” (Jordana & Levi-Faur

2005: 107), which is often used as a roundabout way of describing processes of globalization. This compression allows transnational policy networks to grow and pervade regulatory capitalism. While compression is a useful analogy for what happens following a disruptive innovation, they are not interested in the causes of compression, but treat it as a given condition. Furthermore, these studies remain uninterested in what comes before the innovation. Looking backwards in time, at the institutional legacies of innovations, in considered unimportant.

The question of legacy is taken up by Majone: "… it is possible to surmise that the institutional and intellectual legacy of the interventionist state is a major impediment to the speedy adjustment of governance structures to the new strategies" (1997: 163). Here he hints at a notion of path dependence (Pierson 2004). Previous institutional and intellectual choices constrain actors in their present repertoire of available options. Majone argues that in some contexts it is necessary to look backwards in time in order to understand the present. Policy continuity or the 'continuity of concerns' (Landis, quoted in Majone 1997: 153) requires policymakers to delegate some functions to independent authorities that are untouched by the inconsistency of electoral politics. However, in favoring legacy, compression remains unexamined. In the ideal-typical governance impact of disruptive innovation illustrated above, it is precisely the interplay between compression and legacy that creates unique policy problems. In the regulation literature, this interplay remains unstudied.

To inform a theory of the regulatory impact of disruptive innovation that takes matters of time seriously, we can turn to historical institutionalism (e.g. Tilly 1984; Thelen 1999; Pierson 2004). Here, the question of legacy has been dealt with in more detail than anywhere else. However, two shortcomings constrain us from a wholehearted adoption of this school. First of all, historical institutionalism is interested in explaining how a certain outcome was reached as a consequence of past circumstances. Compression and legacy might both be operating, but only in the past. In contrast, I am interested in how a certain outcome is reached as a

consequence of both past circumstances and future possibilities. How an agent acts at a specific point in time will be shaped by his perception of the duration of both past and future time that he deems important to consider. This notion of time horizons is also agent-focused, while historical institutionalism is structure-focused (Hall & Taylor, 1996). Second, historical institutionalism sees all relevant information as contained in the institution (Seabrooke 2007). As the regulation literature increasingly comes to emphasize the importance of transnational networks of professionals and experts as endogenous sources of change (Jordana & Levi-Faur 2005: 118), it is becoming clear that this viewpoint is empirically untenable. The task is therefore to construct a theory that allows us to deal with temporal structure, forward-looking and backward-looking, while allowing for the centrality of actors that traverse national and institutional borders. Andrew Abbott, whose methodological work inspired many historical institutionalists (Pierson 2004), provides us with the appropriate set of tools to do this.

Abbott's unit of analysis are professional ecologies (1988) and especially how they link and interact with each other (2005). An ecology is "a set of social relations … that is best understood in terms of interactions between multiple elements that are neither fully constrained nor fully independent" (Abbott 2005: 248). Ecologies thus exist in the middle range between "mechanism and organism on the one hand and … atomism and reductionism on the other." They consist of actors, locations (a set of controlled tasks) and ligation (processes linking actors to tasks). Focusing on the institutional or organizational level would obscure the practices that go on at levels below and between these structures. Conversely, giving precedence to agents runs the risk of giving too little importance to the institutional context of the agents. The concept of ecologies gets this balance just right by ascribing as it does to a notion of 'structural individualism' (Udéhn 2001), whereby the impact of structures on agents is given equal importance as the impact of agents on structures.

The key analytical advantage of the linked ecologies approach lies in its reconceptualization of the policy arena. Rather than explaining policy outcomes as a consequence of structural, institutional factors on the one hand or as a consequence of the intentions and rationalities of agents on the other, policymaking becomes a competition between professional ecologies to establish jurisdictional control over policy locations (Abbott 2005). This redraws the boundaries around groups of related actors not according to institutional affiliation, but to professional affiliation. A single professional ecology can contain actors from various different institutional contexts, who are united in the pursuit of a policy outcome that will 'aggrandize' their profession. This perspective allows us to consider political phenomena that are largely overlooked by the literature such as 'revolving doors' between government and industry (Seabrooke & Tsingou 2009). What motivates actors in this perspective has more to do with the everyday dispositions ingrained in work tasks (what Bourdieu calls habitus) and less to do with any overt calculation on the part of the actors or the transformative power of norms and ideas. Abbott suggests two ways in which ecologies link to each other in their attempt to control locations: either by 'hinges', which are strategies or innovations that provide rewards in multiple ecologies, or by 'avatars', which is the expansion of one ecology into another (Abbott 2005). Fourcade and Khurana (2013) use this approach to explain the co-evolution of economic science and business education over the course of the twentieth century.

How do ecologies change in time? Ecologies have a 'temporal grain' (Abbott 2005: 254, 264). When we look at how an ecology changes over a duration of time, the finer the grain of the duration, the more detail is contained in each individual 'slice' of time. Abbott uses the metaphor of rhythm[2] to discuss the historical acceleration of the rhythm of professional life. In the 19th century, professionals were educated in their youth, and their knowledge and skills would last for a lifetime. This was a period with a coarse temporal grain due to the slow rate of change. In the 20th century however, engineers, for example, would come to see their

[2] Although 'tempo' seems more appropriate.

knowledge become obsolete before the end of their careers. In the modern information economy, knowledge is overturned even more rapidly. Here the ecologies have a finer temporal grain, as each individual slice of time will have increasing amount of detail. The temporal granularity of an ecology is therefore linked to the rate of change it experiences in actors, locations and ligations.

As previously mentioned, actors' decisions are shaped by their time horizons, which I defined as the period of time actors deem meaningful when determining a course of action. It is important to note that this definition differs from the one offered by Abbott (2001: 173), where he defines it as the period of time over which meaningful change occurs in a variable. The definition I put forward is anchored in the perceptions of agents. This is closer to the more commonplace idea of time horizons as planning horizons, or a fixed point in time in the future at which certain processes will be evaluated. However, time horizons, as defined in this paper, can also extend backwards in time. Looking backwards, agents may deem past occurrences, histories or trajectories as relevant or meaningful in determining how to act in the present. Time horizons may even be unconscious, and in this conception we draw closer to ideas of path dependence. Past institutional choices can constrain the repertoire of actions that are possible or even considered by agents in the present (Pierson 2004).

When disruptive innovation upsets the status quo of a market, it introduces a period of rapid change. The market ecologies affected by the change will experience a much finer temporal grain. For a given time horizon, the amount of information contained in that time horizon will increase dramatically. Overwhelmed by change, actors are forced to compress time horizons, perhaps planning in terms of days or weeks instead of months or years. Previously held time horizons spanning longer durations into the future will be invalidated. Not all ecologies will respond to the disruptive innovation simultaneously: weighed down by legacy, it may take time for regulators to adjust rules and perceptions, even as current regulation becomes invalidated. Regulatory headaches in the form of governance crises arise. Collisions between different time horizons are inevitable as

competing ecologies will attempt to assert their perception of events as the dominant one. How this impacts the field of positions, network ties and status signals of the ecologies will have great bearing on the renewed bouts of competition to establish jurisdictional control over disrupted policy locations. If we want to study the regulatory impact of disruptive innovation, the theoretical considerations outlined here must be addressed.

Conclusion

In this paper I have argued that the impact of disruptive innovation on regulatory capacity and process is important and understudied. In order investigate the issue, we need to give theoretical centrality to professional ecologies and time horizons. I have accounted for how disruptive innovation causes the temporal grain of ecologies to become dramatically more fine, and why this is such a pain for regulators to deal with, in theory. The open question is how this plays out in practice, and how the assertions made here can be verified empirically, which must be addressed in future research.

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