Regulatory Roles and Functions in Information-Based Regulation: A Systematic Review

Frances Bowen and Panos Panagiotopoulos

School of Business and Management, Queen Mary University of London

Mile End road, London, E1 4NS, United Kingdom

F.Bowen@qmul.ac.uk and P.Panagiotopoulos@qmul.ac.uk

Abstract

Information-based regulation (IBR) occurs when regulators use information to drive changes in behaviours to achieve public policy objectives. IBR has emerged as an alternative way to regulate firms compared with more traditional direct command-and-control and market-based policy instruments within the contemporary regulatory state. Despite growing international interest, challenges remain in understanding the roles for regulators in IBR, the functions of regulators in shaping and leveraging information flows, and the administrative capacities required to fulfil them. Based on a systematic review methodology, this article synthesises the findings of 130 peer-reviewed papers in the environmental, energy and food policy areas. It develops a typology of functions for regulators and outlines the new administrative capacities required in the contemporary regulatory state, particularly in standard setting, assurance and intermediation, and smart data management.

Points for practitioners

Regulation by information is becoming popular in many part of the world beyond its original genesis in the USA and other developed countries. The design and implementation of such schemes creates new challenges for regulators. Our review integrates relevant research in three policy areas (environment, food, energy) and develops a new typology of functions performed by regulators. The article is the first to discuss how the roles and functions of regulators need to change in the contemporary information and regulatory environment. It also emphasises the importance of regulatory involvement in IBR, which has traditionally been seen as a deregulatory approach.

Keywords

Information-based regulation; smart disclosure; administrative capacity; systematic review; regulatory state

Introduction

Over the last two decades, regulators have placed increasingly detailed disclosure requirements on firms. Publishing nutritional information on food products, posting restaurant hygiene 'scores on the doors', and listing pollutant emissions on online inventories have all been used as a way to indirectly regulate firms' behaviours. These are examples of information-based regulation (IBR), an intentional form of intervention by regulators in which information is used as a primary mechanism to influence firm behaviours to achieve public policy objectives. Interest in IBR has been rising within the Better Regulation agenda in Europe (Radaelli and Meuwese, 2009) and the Obama administration's smart disclosure task force (National Science and Technology Council, 2013). IBR has also spread far beyond its initial genesis in the USA and other developed countries like the UK and Japan to emerging economies like Philippines, Indonesia and China (Blackman, 2008; Lee, 2010; Lee et al., 2013).

Despite growing international interest, challenges remain in understanding the roles, functions and administrative capacities of regulators to effectively design, implement and maintain such schemes. Regulators need to perform fundamentally different functions to support their new roles compared with earlier modes of regulation such as direct command-and-control or market-based policy instruments. In direct command-and-control, regulators alter firm behaviours through prohibiting certain practices or mandating whether particular technologies can be used or not. These required regulators to develop scientific expertise and conduct risk-based analyses of implemented measures. Alternatively, in market-based schemes like imposing a tax on waste to landfill or subsidising renewable energy, regulators influence firm behaviours through altering economic incentives. This required regulators to apply economic principles to model the impact of markets and prices (e.g. Parker, 1999). In contrast, IBR emphasises public and/or private attempts to increase the availability of information to influence individuals' or firms' choices (Tietenberg, 1998). Using information to trigger desired regulatory outcomes requires administrative capacities beyond risk-based science and market economics. There has been insufficient research so far to understand how regulators can shape the informational context for IBR.

IBR has gained in popularity because, in theory, it offers a way to deliver regulatory outcomes at a lower cost to regulators or is seen as a deregulatory approach (Weil, Graham and Fung, 2013). However, in practice, IBR requires stronger administrative capacity, both in terms of material and managerial regulatory resources, than is usually assumed, especially for such initiatives to be sustained (Newman and Bach 2004; Lee et al. 2013). Although research has discussed a variety of administrative capacities (e.g. Lee et al., 2013; Wegener et al., 2011), the focus has been on the quantity of material and managerial resources needed rather than its nature. We still know too little about the administrative capacities needed to effectively deploy state power through an information-based regulatory framework. Hence, the aim of this article is to address the following questions: (1) what roles and functions do regulators perform in contemporary IBR to influence firms' behaviours? and (2) what are the implications for the administrative capacities required to support these roles and functions?

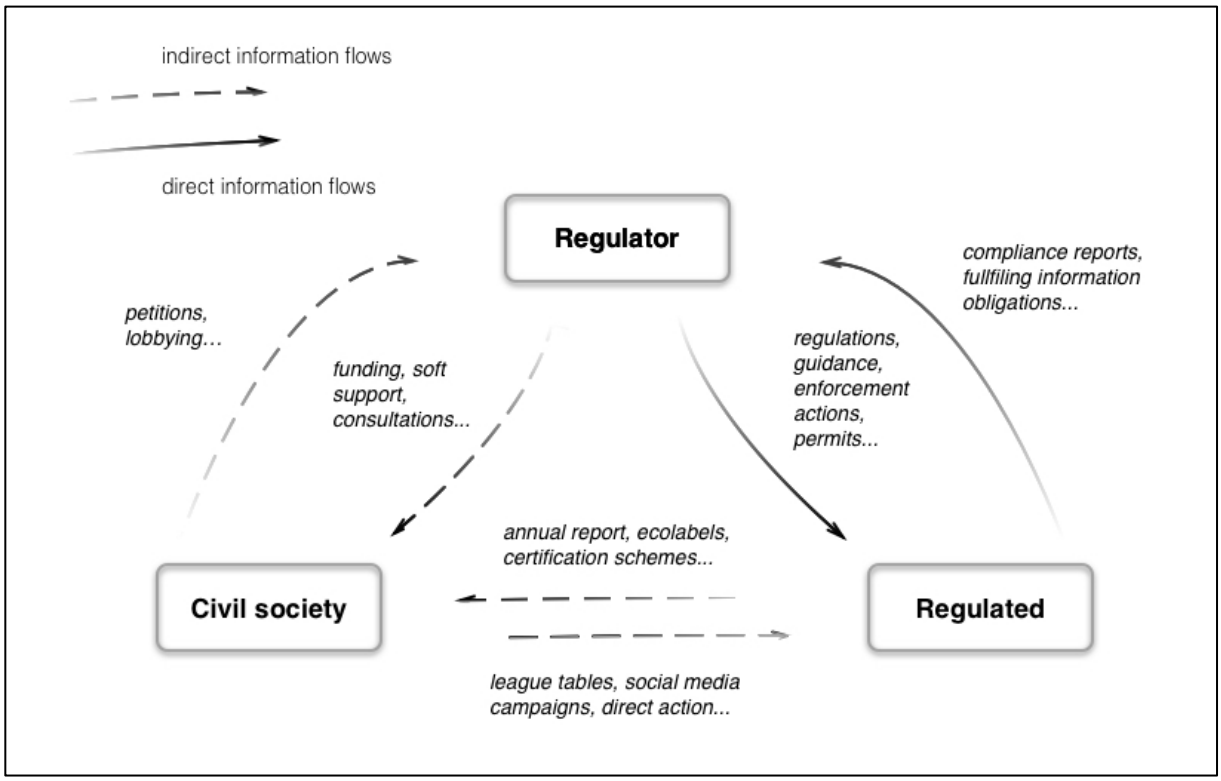
Information-based regulation in the regulatory state

The regulatory state is characterised by using regulatory frameworks to deploy state power, rather than violence, the provision of welfare or directly owning or controlling resources (Walby, 1999; Yeung 2010). IBR is central to new coordination economies where the regulatory state expands

its traditional approach to activities such as standard setting or compiling and distributing market information (Ahdieh, 2010). Within the contemporary regulatory state, regulators are expected to play new roles, including delivering effective behavioural change without direct mandates or owning provision. Using information to shape behaviours is often portrayed as a softer, negotiated form of control deployed by the regulatory state to achieve policy objectives (Moran, 2003).

IBR poses new challenges within the regulatory state as regulators attempt to harness information that they cannot directly control, particularly within network arrangements and especially in a transnational context (Rommel and Verhoest, 2014; Sabel and Zeitlin, 2012). As result, IBR can require different types of involvement by regulators. Although IBR is often portrayed as a deregulatory instrument, the balance of research so far suggests that IBR works when there is a regulatory 'gorilla in the closet' (Rees, 1997; Verbruggen, 2013) or where schemes operate 'in the shadow of the regulator' (Short and Toffel, 2008). IBR requires sufficient administrative capacity to monitor and enforce (Lee, 2010; Lee et al., 2013), even though the key capacities needed in the contemporary regulatory state may be widely dispersed amongst both state and non-state actors (Black, 2001) and unevenly within the state sector (Newman and Bach, 2004). While theorists recognise the importance of administrative capacities to support the operation of IBR, too little is known about the skills and competences needed within regulatory agencies to make IBR work.

Figure 1. Indicative information flows in IBR



In theory, IBR can influence the behaviour of individuals, households, consumers, firms and governments through various economic, psychological or socio-political mechanisms (e.g. (Konar and Cohen, 1997; Lee, 2010; Thaler and Sunstein, 2008). Previous research has shown that information disclosure can drive changes in business behaviours either directly or indirectly through the reactions of consumers, investors, media and other social actors (see Figure 1). As regulators place direct information obligations, guidance and mandatory requirements on firms, firms need to change their internal practices to be able to deliver. Simply implementing an internal measurement, reporting and disclosure system can improve managers' awareness of firms' processes (Lim and Prakash, 2014). However, these schemes have had less than anticipated success in direct behaviour change due to high set up costs and the social dynamics and political interests around new auditing practices (Fleiter et al., 2012). IBR can also drive indirect behaviour changes within the markets and social structures in which information flows are embedded (Fung et al., 2007). Mandating or encouraging corporate disclosures can assist a range of civil society actors in determining whether a firm is meeting their expectations; in turn, research has shown how firms respond to being rated by regulatory agencies, investor groups or third party rating agencies (e.g. Chatterji and Toffel, 2010).

A large body of literature has now developed on different types of IBR, operating in different contexts, and studied from different theoretical perspectives. No study has yet looked across this emerging literature to understand what operating within the 'shadow of the regulator' entails beyond simply mandating disclosure or enacting enforcement within the contemporary regulatory state. What does the current research tell us about regulatory roles and functions in IBR, and the administrative capacities required to fulfil them? These are the questions that our systematic review seeks to address.

Systematic review methodology

We conducted a formal literature review to provide evidence-based answers regarding the current state of knowledge in a systematic, transparent and replicable way. We sought to identify all relevant academic sources that addressed the role and functions of regulators in influencing firm behaviours through IBR. We further narrowed down the search to schemes in the three policy areas of environment, food and energy. The three areas share common challenges on how to reduce risks to the public and encourage businesses to raise quality standards at the lowest overall costs to society. Businesses often contribute to public health and environmental hazards through their industrial processes or final products (e.g. food-borne illnesses, poor restaurant hygiene, waste disposal, greenhouse gas emissions). Therefore, regulators are in search of alternative ways to manage hazards by influencing firm behaviours. The choice of these areas includes some of the most prominent examples of IBR schemes (e.g. nutritional labels, voluntary environmental audits, energy labels) while ensuring sufficient plurality to distinguish contextual effects.

We searched the EBSCO Business Source Complete database to identify and select relevant peer-reviewed articles from the academic literature. We collated all scholarly journals within the database in English for papers with a combination of search terms in the title or abstract. Due to the very wide literature base, we experimented with several variants of keywords to generate a manageable number of sources. Each search term included a combination of a concept term and a domain term. Concept terms covered the most important keywords associated with IBR, which included: 'information disclosure', 'corporate disclosure', 'mandatory disclosure', 'information-based', 'reporting', 'rating*', 'audit', 'scorecard', 'label*', 'screen*', 'social regulation', 'soft

law' or 'transparency'. Domain terms assured the relevance of each article to one of the chosen policy areas, namely: 'enviro*', 'pollution', 'food' or 'energy'.

Initial searches generated a list of 9,716 abstracts. Due to this large number, we conducted a manual relevance screen based on the paper title and abstract only. Common reasons for screening out papers at this stage were because they included alternative meanings of words (e.g. 'enviro*' generated many papers on the business rather than the natural environment); they were too technical (e.g. how to do an energy audit); or were clearly related to behaviours at the individual rather than the firm level. We then downloaded the remaining 211 full text papers for a more detailed screening process. We excluded 81 papers at this stage because they did not include any functions for regulators (e.g. economic models of willingness to pay for voluntary ecolabels), or focused exclusively on internal information management without public disclosure (e.g. internal audits).

Both authors coded the final set of 130 papers based on the full paper and ambiguities about the coding process were resolved through discussion. We coded each paper's main features based on: country, discipline, policy area, name of schemes, theories used, rigor and strength of evidence. We also noted findings on the context, primary drivers, design and effects of IBR schemes. Finally, the coding process sought evidence about the functions of regulators in IBR schemes and the contextual and administrative factors that supported these functions. We generated a list of first order concepts, that is, of all regulatory functions mentioned in the IBR schemes. We then clustered these into six second order themes using the Gioia (2012) method for analysing qualitative data.

Findings

Academic research addressing IBR has grown rapidly over recent years, and now includes studies from many international contexts, of different schemes, and using a wide range of theoretical approaches. Of the 130 papers, over half of them (72 or 55%) were published in 2008 or later, with 15 papers published in 2014 alone. The environment was the most represented policy area with 83 papers (64%), followed by food (29 or 22%) and energy (18 or 14%). Environment has dominated the literature from the mid-1990s when economists began researching the US EPA's Toxics Release Inventory (TRI). A more recent resurgence of IBR interest in food policy addresses the potential of labels on food packaging to encourage healthier consumption choices (12 papers within 2012-14 alone). Over the last decade, papers demonstrate increasing methodological complexity, including content analysis of firms' disclosures, mixed-method case studies, interviews with stakeholders, and surveys of both information users and disclosures.

The international reach of IBR research has also been growing. North America dominates the examples and case studies with 53 publications based on US data, including almost all the studies published before 2000. Canada, the UK and European Union were identified as the focus in 7 papers each, while 19 publications attempted comparative analyses of schemes across two or more countries. There is a more recent emergence of research on IBR in Asian countries like China (5 papers), Indonesia (1), India (1) and the Philippines (1). Australia and Germany were the focus in 4 papers each, followed by France (3), Hong Kong (2) and Mexico (2).

Table 1 provides an overview of the schemes identified. Pollutant release and transfer registers (PRTRs) are the most frequently researched in the environmental domain and, within these, the US EPA's Toxic Release Inventory (TRI) is by far the most researched scheme with over 10% of the papers addressing the TRI alone. Also prominent are studies of auditing schemes where firms

follow agreed processes to evaluate their performance and declare their own results to either the regulator or on a public register (e.g. energy efficiency or environmental compliance audits). Audits are particularly common in so-called 'self-policing' regimes (e.g. USA, Australia) where compliance enforcement is assured through firms monitoring their own performance (Stafford, 2007). An important distinction between the different schemes is whether information disclosure is mandatory or voluntary; about even numbers reported on voluntary (50) and mandatory (44) schemes and 25 papers addressed both. Mandatory disclosure schemes dominated the earlier literature, with voluntary disclosure schemes appearing mainly from the late-1990s.

Table 1. Types of schemes identified by policy area

	Environment	**Food**	**Energy**	**Total**
Product labels	6	22	6	34
Audits	15	0	6	21
Pollutant registers	17	0	0	17
Corporate reporting	12	0	1	13
Industry-led schemes	7	0	2	9
Company ratings	0	2	1	3
Management systems	2	0	0	2
Total	59	24	16	99

Note: only papers based on specific, identifiable schemes are included in this table.

It is difficult to draw firm conclusions on the factors that drive the effectiveness of IBR because of the enormous diversity among the schemes and research methods within the sample. Our review confirmed that government-sanctioned schemes require sufficient administrative capacity to maintain their functioning (e.g. Lee, 2010; Lee et al., 2013; Short and Toffel, 2008). Another clear implication is that small changes in implementation can make a large difference to the effectiveness of the schemes. Although not the main focus of the review, we identify three sets of factors that influence IBR effectiveness: (1) the characteristics of the policy domain; (2) the characteristics of the regulated firm; and (3) information users and flows between actors (see Table 2). These drivers of IBR effectiveness are discussed in previous work (e.g. Fung et al., 2007: Lee, 2010; Mitchell, and Lee et al., 2013).

Functions for regulators in IBR

While many studies touch on the functions of regulators, few reflect on the implications of these functions for administrative capacity in the regulatory state. Few academic papers directly addressed regulatory functions beyond the core choice of whether to require mandatory disclosure of information (Esty (2004) is a notable exception). Our detailed coding revealed six primary functions that regulators play in IBR as summarised in Table 3.

Table 2. Factors that influence the effectiveness of IBR schemes

Category	Main findings
Characteristics of the policy domain	– IBR most appropriate when the hazard posed by the policy problem presents low to medium risk; only as a supplementary measure where there is significant risk of environmental harm (Bizer and Julich, 1999; Uchida, 2007). – Successful IBR requires commitment by lead actors, whether state agencies or lead private-sector participants (Gouldson et al., 2008).
Characteristics of the regulated firm	– IBR can work when firms have incentives to disclose information other than compliance (Gallastegui 2002). – Effective IBR schemes leverage indirect pressures by tapping into reputational and legitimacy effects (Brammer and Pavelin, 2008; Gouldson et al., 2008). – Firms led by general managers with MBAs more likely to participate in IBR schemes than firms led by lawyers (Lewis et al., 2014). – IBR can facilitate firms' internal learning when senior managers embrace disclosure as an opportunity rather than a threat (Sharma, 2000). – Schemes that require high involvement from information disclosers (e.g. energy audits) more likely to be successful (Delmas et al., 2013).
Information users and flows between actors	– Effective IBR requires stakeholder interest in the information disclosed, but not all topics generate similar interest (Huang and Kung, 2010). – IBR particularly effective in changing behaviours when the disclosure is highly salient to information users (Weil et al., 2006); e.g. health warnings on products more likely to change buying behaviours of families with children than other consumers (Bae 2012). – IBR works best when information can be presented simply, succinctly and consistently (Banerjee and Solomon, 2003; Gouldson et al., 2008; Weil et al., 2006). – IBR most powerful when information is disclosed closer to the time of decision-making (Fung et al., 2007; Weil et al., 2006); e.g. restaurant hygiene rating schemes where scores are available on the door (Ho, 2012).

The main function for regulators discussed in the literature is to set the framework. Regulators can require mandatory disclosure of a firm's performance to be published either in online inventories (e.g. PRTRs), or displayed on the product or service itself (e.g. restaurant scores on doors). Regulators can also set the framework in voluntary schemes by providing incentives to disclose (Esty, 2004). In the case of the US EPA's Audit Policy, the scheme provides explicit incentives for voluntary disclosure through regulatory relief. Softer incentives for disclosure may also arise through regulatory support of voluntary pledges. For example, the UK Department of Health's Public Health Responsibility Deal encourages voluntary disclosure about food products within an implicit regulatory threat that if voluntary disclosure does not alter firm behaviour then mandatory measures might follow. Part of setting the framework is to design information

standards. The UK's Department for Energy and Climate Change, for example, has developed guidelines on when firms can legitimately claim carbon neutrality. Finally, regulators can signal policy priorities through reports and other mechanisms including their own strategic plans (Giles, 2013).

Table 3. Functions of the regulator in IBR

Main function *(Second order theme)*	**Indicative activities** *(First order category)*	**Indicative references**
Function 1: Setting the regulatory framework	1.1 Requiring mandatory disclosure 1.2 Providing incentives for firms to disclose 1.3 Recommending or proposing voluntary guidelines 1.4 Setting information standards 1.5 Participating in multi-stakeholder and multi-national agreements 1.6 Signalling policy priority	Lee (2010) Giles (2013) Esty (2004)
Function 2: Making government information widely accessible	2.1 Collating and maintaining official databases 2.2 Developing standard indicators	Tan (2014) Evans and Campos (2013)
Function 3: Developing public information programs	3.1 Public education campaigns 3.2 Providing technical assistance to firms 3.3 Developing audit processes	Gouldson et al. (2008) Anderson and Newell (2004)
Function 4: Delegating authority to a third party standard-setting body	4.1 Funding and/or endorsing standards organisations	Glachant (2002) Esty (2004)
Function 5: Assuring others' information	5.1 Endorsing others' guidelines 5.2 Assuring a third-party's information disclosure 5.3 Improving data credibility 5.4 Guarding against disinformation	Lim and Prakash (2014) Upham et al. (2011) Hoek and King (2008)
Function 6: Formatting, displaying, aggregating data	6.1 Formatting and merging data 6.2 Standard-setting for data formats	Hogner (2008) Bae et al. (2010)

The second function for regulators is to make government information widely accessible. Public authorities may be able to gain economies of scale in data collection and then share these for the broader public benefit (Esty, 2004). This function is most obvious in pollutant registers such as DEFRA's ambient air quality and other indicators on the UK-AIR website. However, several studies point out that simply collating the data is not enough: there can be considerable technical challenges and time delays in making public data available (Evans and Campos, 2013). Making data available can be enhanced by using formats that facilitate interoperability standards

or by establishing Application Programming Interfaces (API) for wider distribution to developers. For example, the Food Hygiene Ratings of food establishments in the UK are available via a specially developed API by the Food Standards Agency. This separates the function of the Food Standards Agency in collecting and making the data available from the distribution activities of other information intermediaries like mobile application developers that can process and visualise the data for other uses.

A third function for regulators is to develop public information and education programs to promote regulatory outcomes and address problems of imperfect information rather than the more usual information asymmetry of disclosure programs (Mitchell, 2011). Regulators may attempt to provide firms and consumers with information designed to remedy their lack of knowledge and so to influence their behaviours. Such education programs can support firms through technical assistance or providing frameworks for audit processes (Anderson and Newell, 2004).

The fourth function for regulators identified is delegating authority to a third-party standard-setting body. For example, a pilot Assurance Scheme by the Environment Agency in England explored the possibility of delegating assurance for Environmental Permitting Regulations to organisations that set the standards for environmental management systems (e.g. ISO 14001) (Environment Agency, 2014). Expanding such a scheme may require authority to be formally delegated to agencies like the Chartered Institute of Environmental Health that certifies professionals in environmental management and related areas. Regulators could also facilitate IBR by setting up credible information clearinghouses or observatories, a so-called 'National Institute of the Environment (Esty, 2004).

The fifth function for regulators identified in current research is to assure others' information. Rather than delegate authority to a third-party organisation, regulators could selectively endorse or assure others' guidelines. For example, firms in the UK can meet their statutory Renewable Transport Fuel Obligation by demonstrating compliance to specific qualifying standards that are advocated, designed and operated by a range of non-statutory organisations (Upham et al., 2011). Another way to assure others' information is improving data credibility. Various studies emphasised new activities for regulators in publishing complaints, finding outliers, making complaints easier to process, ensuring credibility, undertaking public enquiries and setting data accuracy requirements to guard against misinformation (Esty, 2004; Hoek and King, 2008).

Finally, regulators may perform a more technical function in formatting, displaying and aggregating data from a variety of sources. Bae et al. (2010) demonstrated that the way in which regulators processed TRI data played a critical role in achieving the TRI's intended policy goal of better information to end users. They argue that simply making more data available can be counter-productive and conclude that state data processing efforts help more than the information disclosure itself.

Evolving regulatory roles and functions in the contemporary regulatory state

The literature reviewed covers more than two decades of research on IBR. Comparing studies from the early literature with contemporary research, we found that the main roles of regulators have evolved as the emphasis in IBR schemes has shifted from 'right-to-know' approaches to 'targeted transparency' and now to 'smarter disclosure'. All of these types of schemes require regulators to set the regulatory framework, but in addition they also require them to perform combinations of the other functions identified in the review. Our review identified three eras of IBR, each of which corresponds to evolving roles and functions for regulators (see Table 4).

Generic 'right-to-know' policies in the US from the 1960s onwards, required general openness in government in order to hold public officials to account as part of an accountability assurance agenda (Florini, 2007; Mitchell, 2011; Mol, 2010). Beyond setting the framework, the primary functions for regulators in right-to-know IBR is making government information accessible and publicising this through public information and education programs. Freedom of Information Acts supported citizens and other stakeholders in exercising their rights to access information to transparency and openness. As the primary disclosers in the right-to-know frame, regulators shaped the information context through ensuring transparency of governance.

More open deliberation required information, eventually leading to calls for mandatory disclosure schemes such as the US EPA's TRI in 1986. Since then, over 50 countries have launched similar pollutant release and transfer registers (Gouldson, 2004). These are examples of 'targeted transparency' schemes, where firms are required to disclose specific factual information to support better stakeholder decision-making (Fung et al., 2007). The goal is to mandate simplified information disclosure to 'nudge' consumers at the time that they make their decisions (Thaler and Sunstein 2008). Early successes such the US Toxic Release Inventory encouraged schemes in a wide variety of sectors from restaurant hygiene ratings (Ho, 2012) to energy efficiency ratings (Banerjee and Solomon, 2003). The primary role of regulators in targeted transparency IBR is to reduce information asymmetry to manage risks to the public and raise provider quality (Fung et al., 2007). Regulatory functions include providing platforms for firms to disclose information to other stakeholders, particularly consumers. Regulators make government information widely accessible through collating and maintaining official databases, including online inventories. Rather than disclosing the information directly, as in right-to-know, regulators can specify the format and quality of information disclosed through endorsing data credibility and developing audit processes. Thus targeted transparency requires regulators to both delegate more authority for disclosure and to be more specific in the technical requirements for the data disclosed.

The current 'smart disclosure era' has been facilitated by new technologies such as lower-cost sensors and data analytics. 'Smart disclosure' is 'the timely release of complex information and data in standardised, machine-readable formats in ways that enable consumers to make informed decisions' (Sunstein, 2013: 2). Simply mandating disclosure through targeted transparency can lead to data overload and confusion, so smart disclosure involves processing data from a variety of sources to generate decision-relevant data (Bae et al. 2010; Evans & Campos 2013). In the smart disclosure era, regulators are mandated to engage intermediaries and encourage the market discipline stimulated by the potential availability of information. Regulators can shape the information environment so that disclosures by a wide variety of stakeholders are accessible to information intermediaries and final users. They need to delegate authority, assure others' information and develop standards for formatting, displaying and aggregating data.

Thus changes in legal, technical and stakeholder environments challenges the regulatory system to evolve the roles and supporting functions played in influencing behaviours through information. In the contemporary regulatory state, smart disclosure is both more delegated and more technically specific than in previous IBR regimes. Regulators additionally face the challenge that right-to-know and targeted transparency schemes are still popular forms of IBR, requiring versatility in performing different functions simultaneously.

Table 4. Roles and functions of the regulator over time

	Right-to-know (1960s onward)	**Targeted transparency (1980s onward)**	**Smart disclosure (2000s onward)**
Regulatory roles	Improve government accountability and transparency	Reduce information asymmetry to manage risks to the public and raise provider quality	Reduce cost of information and generate value from distributed data
Primary disclosers	Government	Firms	Governments, firms, individual consumers
Primary users	Citizens and other stakeholders	Consumers	Information intermediaries (incl. government, app developers etc.)
Enablers	Legal: Freedom of Information Acts (primarily USA federal act in 1966)	Legal: Freedom of Information Acts introduced in other developed countries in 1980s and 90s Technology: Web-based inventories; cheaper communication	Technology: Cheap and distributed sensors; big data analytics; open data standards
Functions of the regulator	Function 1: Setting the regulatory framework Function 2: Making government information accessible Function 3: Public information programs	Function 1: Setting the regulatory framework Function 2: Making government information widely accessible Function 3: Public information programs	Function 1: Setting the regulatory framework Function 4: Delegating authority Function 5: Assuring others' information Function 6: Formatting, displaying, aggregating data
Illustrative references	Florini (2007) Mol (2010)	Fung et al. (2007) Mitchell (2011) Lee (2010) Tietenberg (1998)	Shadbolt (2013) Sayogo et al. (2014) Thaler & Tucker (2013)

Discussion

IBR is often assumed to be 'lighter touch', with less regulatory involvement than command-and-control and market-based regulation. However, our review confirms that IBR is most effective when backed by a credible commitment and active involvement by regulators or what has been characterised as 'the shadow of the regulator' (Newman and Bach, 2004; Short and Toffel, 2008). This prompted our investigation of regulatory roles and functions in IBR, what administrative capacities are required by the regulatory state to fulfil them, and the implications for the theory of IBR more broadly.

Implications for administrative capacities of the regulatory state

While earlier forms of IBR relied on the generic and centralised capacity to provide information on request, the smart disclosure era requires more advanced capacities to support regulators' new functions. On one level, these capacities are about keeping an eye on the overall purpose of IBR, and not focusing on data-driven solutions for their own sake (Evans & Campos, 2013). On a more advanced level, regulators are challenged to develop the capacity to strike a delicate balance between ceding direct control of gathering, collating and publishing data on the one hand, and providing sufficient assurance that IBR schemes are credible on the other. Our study highlights three complementary but distinct aspects of administrative capacity that underpin regulators' ability to manage these tensions in the contemporary smart disclosure era: standard setting, assurance and intermediation, and smart data management.

First, IBR challenges regulators to deepen competence in standard setting. Mandatory IBR schemes require that regulators develop skills in developing, testing, certifying and enforcing specific information standards and formats so as to influence the rules of the game. Standard setting reflects the economic tradition in IBR research (e.g. Uchida 2007; Delmas, Montes-Sancho, and Shimshack 2010) but the new analytical competences required are quite different from the engineering-oriented skills of direct command-and-control regulation or the economic modelling skills of market-based regulation. The rise of voluntary IBR schemes to ensure regulatory compliance challenges regulators to seek input from new analytical professions and experts that specialise in the psychology of behavioural change, rather than the rational economics of cost-benefit calculus. For example, the rise of the Behavioural Insights Team (Nudge Unit) in the UK and the Office of Information and Regulatory Affairs in the USA required new teams to develop, test and shape specific information standards (Sunstein, 2013).

Second, IBR challenges the regulatory system to develop administrative capacity to assure standards and mediate between firms and information certifiers. This capacity is emphasised in the socio-political tradition of IBR research that draws on theories of legitimacy, accountability and institutional effects in delegated IBR schemes (e.g. Eisner 2004; Short & Toffel 2008; Darnall et al. 2009). In smart disclosure, authority is delegated and requires the involvement of different actors who might have diverse stakes in setting and enforcing standards. Hence, regulators' authority is no longer centralised and more commonly involves relationship management, endorsement and communication with stakeholders who have delegated authority to collect, disclose and use information. By making it easier for consumers, investors, media, NGOs and others to access information they need, regulators can put pressure and reward firms for good performance. This requires regulators to develop competences in understanding information supply from firms and information demand from consumers, investors, NGOs and publics. Intermediation and assurance are vital to the trust and credibility needed for delegated IBR schemes to work.

Finally, effective IBR requires regulators to become more adept at smart data management. More than any other type of regulatory initiative, IBR schemes require careful consideration of information management strategies, especially around the use and availability of data that might come from diverse sources. This capacity has traditionally been more of an internal technical challenge (e.g. transforming and displaying data) but advancements in smarter disclosure technologies (Pirog, 2014) offer new opportunities to achieve regulatory objectives (e.g. Internet of Things environments, connected devices, data analytics and visualisation tools). However, to do this, regulators need the digital competence to see these new opportunities or the ability to support other challengers to disrupt current data uses. On a broader scale, regulators can consider

how value creation ecosystems can develop around the smart use of data. For example, the Food Hygiene Ratings scheme in the UK makes restaurant scores available in several ways that maximise the value of the data (e.g. stickers on doors, public website search, application programming interface for developers).

Implications for IBR theory

Focusing on the functions of the regulators and the administrative capacities required to implement IBR poses challenges for future work on the theory of IBR more broadly. For example, there may be situations where multiple regulators might be using IBR approaches for their respective policy goals (e.g. food standards, environmental health) to target the same firms or consumers. The behaviour change assumptions that regulators rely on in designing IBR programmes one at a time may not operate in the same way when those same firms or consumers are simultaneously exposed to the information required by other regulators. This raises questions for IBR theory on the scalability of IBR, when multiple regulators are targeting the same firms or consumers.

IBR theory also tends to implicitly assume a 'hub and spoke' pattern of inter-organisational connections between regulators and regulated firms. The proliferation of regulators and of fora in which firms can interact and learn from each other on regulated seriously challenges this implied pattern. Future IBR theory needs to better contextualise information flows within a rich network of firms, their competitors, supply chains and their stakeholders.

Conclusion

Our review synthesised academic research and emphasised the importance of regulatory involvement in IBR, which has traditionally been seen as a deregulatory approach. The primary contribution has been to unpack the roles and functions of regulators in IBR, and the new administrative capacities required in the contemporary regulatory state. The article thus expands previous work on administrative capacities required for IBR to identify the competences and skills needed by regulators. While there has been increasing interest in IBR from both practical and academic perspectives, this article is the first to focus on the functions of the regulators and to outline how these functions may need to change in the contemporary information and regulatory environment.

Acknowledgments

We gratefully acknowledge funding support from the Better Regulation Executive (BRE) within the Department for Business, Energy and Industrial Strategy (BEIS) and the Regulatory Policy Committee (RPC), specially the members of the BEIS steering group that provided valuable feedback. Furthermore, we would like to acknowledge the excellent research assistance of Rebecca Kriegbaum. Finally, our gratitude goes to Prof Perri 6 from Queen Mary University of London for offering helpful guidance and comments throughout the development of the article.

References

Ahdieh RB (2010) The Visible Hand: Coordination Functions of the Regulatory State. *Minnesota Law Review* 95(2): 578–649.

Anderson ST and Newell RG (2004) Information programs for technology adoption: the case of energy-efficiency audits. *Resource & Energy Economics* 26(1): 27.

Bae H (2012) Reducing Environmental Risks by Information Disclosure: Evidence in Residential Lead Paint Disclosure Rule. *Journal of Policy Analysis & Management* 31(2): 404–431.

Bae H, Wilcoxen P and Popp D (2010) Information disclosure policy: Do state data processing efforts help more than the information disclosure itself? *Journal of Policy Analysis & Management* 29(1): 163–182.

Baldwin R (2010) Better regulation: The search and the struggle. In: Baldwin R, Cave M, and Lodge M (eds), *The Oxford Handbook of Regulation*, Oxford University Press.

Banerjee A and Solomon BD (2003) Eco-labeling for energy efficiency and sustainability: a meta-evaluation of US programs. *Energy Policy* 31(2): 109.

Bizer K and Julich R (1999) Voluntary agreements -- trick or treat? *European Environment: The Journal of European Environmental Policy* 9(2): 59.

Blackman A (2008) Can Voluntary Environmental Regulation Work in Developing Countries? Lessons from Case Studies. *Policy Studies Journal* 36(1): 119–141.

Brammer S and Pavelin S (2008) Factors influencing the quality of corporate environmental disclosure. *Business Strategy & the Environment* 17(2): 120–136.

Chatterji AK and Toffel MW (2010) How firms respond to being rated. *Strategic Management Journal* 31(9): 917–945.

Darnall N, Seol I and Sarkis J (2009) Perceived stakeholder influences and organizations' use of environmental audits. *Accounting, Organizations & Society* 34(2): 170–187.

Delmas M, Montes-Sancho MJ and Shimshack JP (2010) Information disclosure policies: Evidence from the electricity industry. *Economic Inquiry* 48(2): 483–498.

Delmas MA and Lessem N (2014) Saving power to conserve your reputation? The effectiveness of private versus public information. *Journal of Environmental Economics & Management* 67(3): 353–370.

Delmas MA, Nairn-Birch N and Balzarova M (2013) Choosing the Right Eco-Label for Your Product. *MIT Sloan Management Review* 54(4): 10–12.

Eisner MA (2004) Corporate Environmentalism, Regulatory Reform, and Industry Self-Regulation: Toward Genuine Regulatory Reinvention in the United States. *Governance* 17(2): 145–167.

Environment Agency (2014) *EPR Assurance Trial*. Bristol, UK.

Esty DC (2004) Environmental protection in the information age. *New York University Law Review* (79): 115.

Evans AM and Campos A (2013) Open Government Initiatives: Challenges of Citizen Participation. *Journal of Policy Analysis and Management* 32(1): 172–185.

Fleiter T, Schleich J and Ravivanpong P (2012) Adoption of energy-efficiency measures in SMEs—An empirical analysis based on energy audit data from Germany. *Energy Policy* 51: 863–875.

Florini A (2007) *The right to know: transparency for an open world*. Columbia University Press (ed.), New York.

Fung A, Graham M and Weil D (2007) *Full Disclosure: The Perils and Promise of Transparency*. Cambridge: Cambridge University Press.

Giles C (2013) Next Generation Compliance. *Environmental Forum*: 22–26.

Gioia DA, Corley KG and Hamilton AL (2012) Seeking Qualitative Rigor in Inductive Research: Notes

on the Gioia Methodology. *Organizational Research Methods* 16(1): 15–31.

Glachant M, Schucht S, Bültmann A, et al. (2002) Companies' participation in EMAS: The influence of the public regulator. *Business Strategy & the Environment* 11(4): 254–266.

Gouldson A (2004) Risk, regulation and the right to know: exploring the impacts of access to information on the governance of environmental risk. *Sustainable Development* 12(3): 136–149.

Gouldson A, Lopez-Gunn E, Van Alstine J, et al. (2008) New alternative and complementary environmental policy instruments and the implementation of the Water Framework Directive. *European Environment* 18(6): 359–370.

Ho DE (2012) Fudging the Nudge: Information Disclosure and Restaurant Grading. *Yale Law Journal* 122(3): 574–688.

Hoek J and King B (2008) Food advertising and self-regulation: A view from the trenches. *Australian & New Zealand Journal of Public Health* 32(3): 261–265.

Hogner RH (2008) Environmental Regulation through Public Disclosure: PRTRs in the Information Age. *Journal of Global Business Issues* 2(1): 1–11.

Huang C-L and Kung F-H (2010) Drivers of Environmental Disclosure and Stakeholder Expectation: Evidence from Taiwan. *Journal of Business Ethics* 96(3): 435–451.

Konar S and Cohen MA (1997) Information as regulation: The effect of community right to know laws on toxic emissions. *Journal of Environmental Economics & Management* 32(1): 109.

Lee E (2010) Information disclosure and environmental regulation: Green lights and gray areas. *Regulation & Governance* 4(3): 303–328.

Lee E, Lejano RP and Connelly RJ (2013) Regulation-by-information in areas of limited statehood: Lessons from the Philippines' environmental regulation. *Regulation & Governance* 7(3): 387–405.

Lewis BW, Walls JL and Dowell GWS (2014) Difference in degrees: CEO characteristics and firm environmental disclosure. *Strategic Management Journal* 35(5): 712–722.

Lim S and Prakash A (2014) Voluntary regulations and innovation: The Case of ISO 14001. *Public Administration Review* 74: 233–244.

Mitchell RB (2011) Transparency for governance: The mechanisms and effectiveness of disclosure-based and education-based transparency policies. *Ecological Economics* 70(11): 1882–1890.

Mol APJ (2010) The Future of Transparency: Power, Pitfalls and Promises. *Global Environmental Politics* 10(3): 132–143.

Moran M (2003) *The British Regulatory State: High Modernism and Hyper-Innovation.* Oxford: Oxford University Press.

Newman AL and Bach D (2004) Self-Regulatory Trajectories in the Shadow of Public Power: Resolving Digital Dilemmas in Europe and the United States. *Governance* 17(3): 387–413.

Parker D (1999) Regulating Public Utilities: Lessons from the UK Experience. *International Review of Administrative Sciences* 65(1): 117–131.

Pirog MA (2014) Data Will Drive Innovation in Public Policy and Management Research in the Next Decade. *Journal of Policy Analysis and Management* 33(2): 537–543.

Radaelli CM and Meuwese ACM (2009) Better Regulation in Europe: Between Public Management and Regulatory Reform. *Public Administration* 87(3): 639–654.

Rees J (1997) Development of communitarian regulation in the chemical industry. *Law & Policy* 19(4): 477–528.

Rommel J and Verhoest K (2014) Exploring effects of coordination on the autonomy of regulators: energy regulators in Belgium. *International Review of Administrative Sciences* 80(2): 298–317.

Sabel CF and Zeitlin J (2012) Experimentalist Governance. In: Levi-Faur D (ed.), *The Oxford Handbook of Governance*, Oxford University Press.

Sharma S (2000) Managerial Interpretations and Organizational Context as Predictors of Corporate

Choice of Environmental Strategy. *Academy of Management Journal* 43(4): 681–697.

Short JL and Toffel MW (2008) Coerced Confessions: Self-Policing in the Shadow of the Regulator. *Journal of Law, Economics & Organization* 24(1): 45–71.

Stafford SL (2007) Should you turn yourself in? The consequences of environmental self-policing. *Journal of Policy Analysis & Management* 26(2): 305–326.

Sunstein CR (2013) *Simpler: The future of government*. New York: Simon & Schuster.

Tan Y (2014) Transparency without Democracy: The Unexpected Effects of China's Environmental Disclosure Policy. *Governance* 27(1): 37–62.

Thaler RH and Sunstein CR (2008) *Nudge: Improving decisions about health, wealth and happiness*. London: Penguin.

Tietenberg T (1998) Disclosure Strategies for Pollution Control. *Environmental and Resource Economics* 11(3–4): 587–602.

Uchida T (2007) Information Disclosure Policies: When Do They Bring Environmental Improvements? *International Advances in Economic Research* 13(1): 47–64.

Upham P, Tomei J and Dendler L (2011) Governance and legitimacy aspects of the UK biofuel carbon and sustainability reporting system. *Energy Policy* 39(5): 2669–2678.

Verbruggen P (2013) Gorillas in the closet? Public and private actors in the enforcement of translational private regulation. *Regulation and Governance* 7(4): 512–532.

Walby S (1999) The new regulatory state: The social powers of the European Union. *British Journal of Sociology.* 50(1): 118-38.

Wegener S, Labar K, Petrick M, et al. (2011) Administering the Common Agricultural Policy in Bulgaria and Romania: obstacles to accountability and administrative capacity. *International Review of Administrative Sciences* 77(3): 583–608.

Weil D, Fung A, Graham M, et al. (2006) The effectiveness of regulatory disclosure policies. *Journal of Policy Analysis and Management* 25(1): 155–181.

Yeung K (2010) The Regulatory State. In Baldwin R, Cave M and Lodge M (eds.), *The Oxford Handbook of Regulation,* Oxford University Press