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Cross-national variations in industry regulation: A factor analytic approach with an application to telecommunications

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Abstract

This study applies factor analytic techniques to 131 telecommunications regulatory agencies in 80 countries to develop a comparative framework for better understanding the cross-national institutional variation in industrial regulation. While some of these measures are specific to the telecom industry (i.e. World Trade Organization Basic Telecom Agreement participation), most of these regulatory variables can be applied to other regulated industries. After analyzing 30 variables, these techniques identify and quantify six distinct dimensions of industry regulation, namely, the competitive market structure rules, industry standards rules, entry barrier rules, institutional stability, political appointment process, and the regulatory governance structure. Despite the conventional wisdom that suggests the "rules of the game" are key to industry regulation, this study finds that the single largest source of cross-national variation is the level of regulatory institutional stability (accounting for 16 percent of the total variation in cross-national industry regulation). This suggests that more focus and attention should be given to the role formal institutions play in industry regulation. This study also finds differences in industry regulation between developed, developing, and least developed nations. Developed countries on average have significantly higher regulation, with the US being the highest. This suggests that regulation is a critical component of industrial regimes and the competitiveness of developed economies.

Keywords: cross-national comparative analysis, factor analysis, industry regulation, principal component analysis (PCA), telecommunications sector.

1. Introduction

The global telecommunications industry moved radically in the last three decades from a global state-ownership model to a regulatory model, which is based on regulation-for-competition by an autonomous regulatory agency on the one hand, and private ownership of the telecommunications services on the other. While the change in telecoms was radical, the process is ongoing and unfolding in many other regulated industries (Levi-Faur 2003; Gilardi 2008; Jordana *et al.* 2011). This trend toward autonomous regulatory agencies is global,

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however, nations vary in the way they each implement regulations, resulting in divergent institutional and market structures.

Regulation scholars have called for research on these cross-national variations, arguing that they have an important impact on the economic, social, and political performance of countries. The *Governance* special issue on the "Varieties of Regulatory Capitalism: Sectors and Nations in the Making of the New World Order" specifically calls for research designed to capture the multiple levels of sector regulation that are embedded in the national context (Levi-Faur 2006). This *Governance* special issue advanced our understanding of cross-national and cross-sector variations in regulation by providing paired examples of telecommunications and electricity comparative case studies, including Germany and France (Humphreys & Padgett 2006); Norway and Switzerland (Bartle 2006); Spain and Portugal (Jordana *et al.* 2006); and Jamaica and Trinidad and Tobago (Lodge & Stirton 2006). Using a similar cross-national case comparative approach, Levy and Spiller (1994) examined telecommunications regulatory institutions across five countries (the United Kingdom, Jamaica, Chile, Argentina, and the Philippines), and revealed the important variation in political institutions in the regulatory process. These studies, which used case comparisons, demonstrated that not just the "rules of the game" (i.e. statutory laws), but other regulatory areas, such as regulator decisionmaking power and institutions, also account for cross-national regulatory variation. Levi-Faur (2003) used a more expansive comparative view across 32 countries to codify the similarities and variations in regulatory regimes between European and Latin American countries.

What still remains unclear is how to quantify the largest sources of variation in industry regulation across nations. A weakness in prior methodological approaches is the inability to quantify these variations. More expansive data that covers all regulated continents, a consistent lens of comparison between countries, and a research methodology that systematically quantifies the variations in industry regulation between countries are all necessary to solving this puzzle of cross-national variation in industry regulation. Doing so would expand our understanding of the key success factors in regulating industries effectively.

This study aims to fill this gap by providing a comparative view of telecommunications industry regulation in 80 countries. Over 131 regulatory institutions are examined to determine the dimensions of regulation that vary most across nations. The main contributions of this paper are: (i) to explicitly reveal six dimensions of regulation that explain the majority (55 percent) of cross-national variations, including *regulatory market structure, regulatory entry barriers, regulatory standards, political appointment process, governance structure, and institutional stability*; (ii) to provide a new methodological approach, principal component and factor analysis data reduction techniques, to identify these key variations; and (iii) to show that regulation varies dramatically between developed, developing, and least developed countries (LDCs), of which the US is the most regulated telecom market.

The first part of the paper offers a new regulatory framework that broadens the conventional view of industry regulation within a country and provides a baseline for cross-national comparison. Comprehensive regulatory measures are identified, collected, and validated using principal component analysis (PCA) and factor analytic techniques to validate the dimensions of regulation. This data is then compiled in the second part of the paper to create an overall cross-national comparative regulatory index for 80 countries. Country-level examples of industry regulation are provided to illustrate the six distinct dimensions of regulation. The third part concludes by providing descriptive statistics on the country-level industry regulatory scores, followed by a discussion on the implications for regulatory scholars, policymakers, and firms investing abroad.

2. Industry regulation: a cross-national comparative perspective

Though much of the seminal research on industry regulation focuses on the differences in the "rules of the game" (Coase 1959; Stigler & Friedland 1962; Demsetz 1968; Koller 1973; Priest 1993), scholars have recently demonstrated that variations in regulation also exist between the regulatory institutions (Levy & Spiller 1994; Levi-Faur 2003; Biela *et al.* 2011; Maggetti *et al.* 2013) and even the power differences between regulatory agents (Levi-Faur 2003; Huising & Silbey 2011; Prado 2012). In order to have a clear view of variations in industry regulation between nations, all aspects of regulation must be considered. A framework of industry regulation, such as that shown in Figure 1, provides a comparative lens to use across countries. This framework focuses on three main aspects of industry regulation – the statutory laws, regulatory institutions, and regulatory agents – so as to identify the sources of variation in 131 telecommunications regulatory agencies in 80 countries. Making sense of this large-scale dataset (i.e. countries and aspects of regulation) in a quantifiable way requires analytical techniques that specifically solve this kind of problem. Having searched broadly across many disciplines for a solution, I borrow an approach from pioneers in the field of psychology (Cattell 1957; Rummel 1970) that provides a set of analytical tools to capture multidimensional entities. The first goal is to examine the regulatory agencies using this regulatory framework to better understand the scope of what is being regulated. I report on these aspects below. Later, in the data and methods section, I return to this analytical solution, factor analysis, to quantify the variations in industry regulation.

2.1. Statutory laws

Statutory laws, as depicted in Figure 1, are rules that govern industry regulations. The classic economic argument suggests that governments regulate utilities to alleviate industry monopolies in three basic ways. They create subsidies for new entrants (Demsetz 1968), set industry prices to alleviate the positive or negative windfalls from unfair competition, and assign territories and technology platforms in the market to alleviate duplication (Coase 1959). For example, in the telecommunications industry, the US judicial ruling in 1984 forced AT&T to break up its

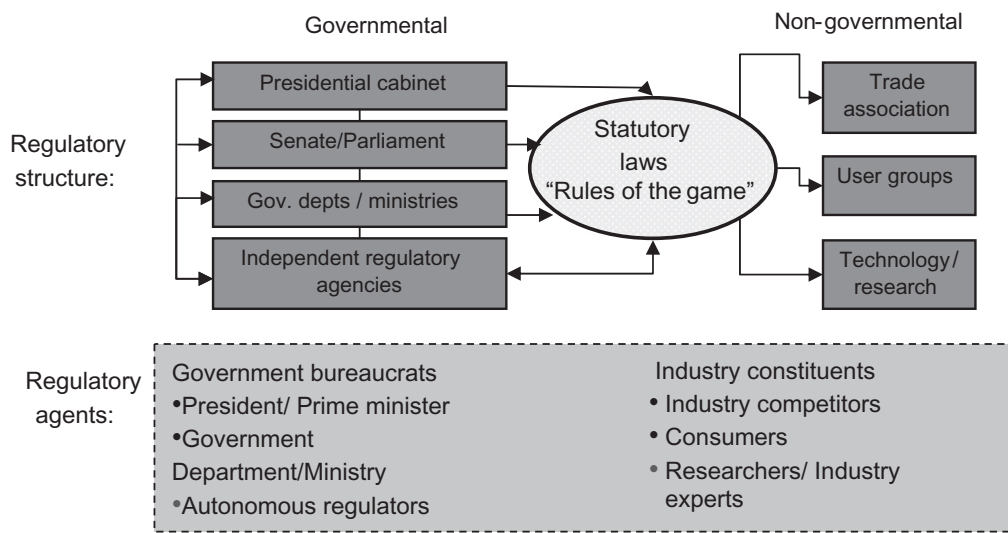

Figure 1 Industry regulatory framework.

monopoly into the well-known Regional Bell Operating Companies (RBOCs) in an effort to increase competition. These *competitive market structure* statutes dictate the rules for competition. They include issuance of licenses, determination of technologies, and specification of antitrust provisions to mitigate competitive conflicts, as well as industry economics and geographic boundaries, such as pricing and the assignment of territories, respectively.

The second type of statutory law that many countries developed pertains to *regulatory standards*. Regulatory standards are rules imposed on industry players that primarily focus on a country's social and environmental considerations. Unlike the competitive market structure rules, these statutes are typically part of a government's policy agenda and mandates. These standards include environmental, safety, maintenance of professional standards or technologies, performance metrics, and social injustice regulations. For example, the US and Botswana mandate social subsidies to under-represented market players and consumer bases, whereas the UK, India, and Brazil do not impose such standards.

The last type of statutory law observed is *regulatory entry barriers*. These regulatory laws impose industry constraints for potential new entrants into the market. Some countries constrain entry by imposing industry-specific foreign investment ownership limitations. These statutes vary significantly across countries. For example, the UK has no foreign ownership restrictions in the telecommunications industry, whereas Canada restricts foreign ownership to 20 percent, and the Canadian Telecom Act and Radiocom Act require all facilities-based carriers to be "Canadian owned and controlled" (Samuels 2003). See table A1 in the online appendix[1] for a complete list of these variations by country. Other entry barrier rules specific to the telecommunications industry include license duration (which ultimately limits the number of new entrants), interconnection with the incumbent network (which regulates revenue sharing within networks), and universal service agreements, such as the World Trade Organization (WTO) Basic Telecom Agreement (which develops shared network standards across countries).

2.2. Regulatory institutional structure

The regulatory structure of most countries is specified by either parliamentary law or presidential/ministerial mandates that create formal regulatory agencies. These laws, or sometimes simply a powerful government officer, bestow authority and accountability on specific agencies that regulate the industry and also specify the interdependencies with other government institutions. Most often the regulatory agencies are governmental departments or independent agencies (e.g. the Federal Communications Commission [FCC] in the US or the Agência Nacional de Telecomunicações [ANATEL] in Brazil). However, in some countries, regulatory responsibilities are assigned to nongovernmental agencies, such as trade associations, user groups, or technology research organizations. For example, one of the Australian telecommunications regulatory agencies, Australian Communications Industry Forum, is made up of telecom service providers, equipment vendors, and customer groups that all collaborate to set the regulatory standards for the industry.

The primary function of these agencies is to broadcast, monitor, impose, and enforce regulatory compliance in the industry. These agencies institutionalize the norms and behaviors specified by statutory laws. Without this level of oversight, the enforcement of key industry regulations is compromised. Simultaneously, the ability to carry out these functions is directly related to the differences in the institutional design. Five regulatory institutional design characteristics that were consistently associated with a stable regulatory agency include:

1 Regulatory agency funding – many government agencies are substantially funded by national general budgets (e.g. Autorité de Régulation des Télécommunications in France). Others are self-funded institutions through levies and sanctions (e.g. Rundfunk- und Telekom-Regulierungs-GmbH regulatory agency in Austria).
2 The duration of regulatory autonomy – represented by the number of years since the regulatory institution received independence from the state-owned telecom provider – is also a determinant of stability. Prior to market liberalization and privatization, regulatory agencies are non-existent at the country level.
3 Type of government institution – the jurisdictional scope granted to the regulatory agency and the levels of hierarchy in the government are important indicators of regulatory institutional stability. In some countries, the regulatory agency is organized through formal government institutions, such as a government ministry or department and federal jurisdiction over the industry. In other countries, regulatory agencies are independent and cannot act legally without the armor of a formal branch of government.
4 The number of agencies required to enforce regulations – multiple agencies having accountabilities to enforce regulations creates a diffusion of power in the regulatory structure and increases overall accountability of the government.
5 Frequency of shifts in the regulatory institutional structure (i.e. reforms) – institutions that shift less frequently – have more embedded and socialized norms that create more efficiency within the institution. For example, the US telecommunications industry regulatory history dates back more than 70 years to the Communications Act of 1934. This institution rarely experiences major regulatory shifts, the most recent being the Telecommunications Act of 1996, which was the first major overhaul of telecommunications law in almost 62 years. Alternatively, in Brazil, since the inception of ANATEL in 1997, telecommunications regulation has undergone 12 regulatory reforms and more than 20 shifts in regulatory statutory law.

More evolved institutional structures suggest that a higher level of enforcement imposed on industry players may be possible. When stability of the regulatory institutions is high, this acts as a credible threat that non-compliant firm behavior will be identified and punished. Non-market strategies likely prevail without these regulatory features.

2.3. Regulatory agents

The third aspect of the industry regulatory framework examines the power of the regulatory agents. The government bureaucrats or, in some countries, the industry constituent groups, are granted the power to regulate by means of imposing the laws, issuing licenses to authorize economic activity, and sanctioning violators of the laws (see Fig. 1). Poorly constrained regulators, a result of the lack of quality governance policies and practices, potentially lead to higher occurrences of corrupt behaviors. Such situations signify a usurping of institutional power from "rule of law" to "rule of man." High levels of individual regulator discretion could lead to inefficient delivery of public goods – in this case, issuing licenses to new entrants. Governments that place weak controls on regulators' actions experience the highest levels of corruption, therefore leading to market inefficiencies. The two mitigating factors that reduce the likelihood of regulator discretion are *the political appointment process*, which generates public pressures and competition for regulatory positions, and *governance structure,* which captures how the governing board is organized and how administrative regulatory staff are allocated. However, the

political appointment process for regulator positions can vary drastically between nations. Important procedural measures in assessing the political appointment process consist of length of term, reappointment limitations, and the basis on which the official obtained power (i.e. elected, self-appointed, presidential appointment, etc.). For example, in Mexico, no term limitations exist for telecommunications regulatory officials appointed by the government; however, in Brazil, the director of telecommunications regulation holds a five-year appointment with no term renewals. The variations in the political appointment process affect the level of power and influence regulators have on industry players. In this comparison, the regulator in Mexico likely has more direct influence given the length in office and the lack of public pressures.

The *governance structure*, on the other hand, measures the organizational configuration and constraints on the regulatory bureaucrats in regulatory institutions. In considering the governance structure, measures such as the number of regulators in a given country that have the power to govern the laws are important considerations of the likelihood of regulation occurring systematically throughout the industry. Governance structure configurations that restrict telecom industry insiders and owners from becoming regulators are beneficial in reducing the level of conflicts of interest between regulators representing the best interest of the industry versus self-interests. For example, in South Korea, all telecommunications commissioners are required to be high ranking political officials, judges, attorneys, professors, or businessmen from consumer protection services, not telecommunications industry executives. Conversely, in Russia many of the regulatory ministers are experienced executives in the telecommunications industry. For example, First Deputy Minister of Communications Yuriy Pavlenko, who was appointed by the President of Russia in January 2000, was the managing director of the Russian telecommunications operator Comstar. The governance board size also varies dramatically between countries. Governing boards that are larger in size provide more exposure and diffused governing power, which inhibits the likelihood of regulators to collude to engage in corrupt behavior. Moreover, regulatory agencies also varied in overall regulatory staff. Larger regulatory agencies potentially benefit from having more bandwidth to regulate. Major functions, such as the issuance of licenses, monitoring of anti-competitive actions, or the enforcement of rules, are more likely to occur with increased regulator capacity.

3. Data and methodology

The primary data collection effort for this research focuses on developing measures that capture industry regulation. A unique methodological approach and detailed dataset were developed to codify regulatory measures. Thirty variables were collected that represent the areas of regulation in the industry regulation framework presented above. While some of these measures are specific to the telecom industry (i.e. WTO Basic Telecom Agreement participation), most of these regulatory variables can be applied to other regulated industries. These regulatory measures are defined in Table 1. Three primary sources are used to collect data on each country's regulatory environment. First, the World Bank International Directory of Utility Regulatory Institutions (IDUR)–Telecoms survey results are used to identify the telecommunications regulator(s) by country. This survey also provided self-reported data pertinent in measuring the content of the regulatory laws, regulatory enforceability responsibilities, and some of the regulatory governance structure measures.[2] Thirteen of the regulatory measures are constructed from this source. Second, the *National Regulatory Authorities Worldwide* (NRAW) country regulatory reports published by Espicom Business Intelligence (1999) are used to create additional variables for 60 of the 80 countries. Each country level report provides information on the regulatory structure,

Table 1 Regulatory variable definitions

Variable	Definition	Calculation
Regulatory competitive market structure	Dimension 1	
Issue service licenses	*All telecommunications services that the regulatory agency issues licenses for, including local services, domestic long distance, international, data services, Telex, leased lines, mobile, paging, cable TV, fixed satellite, mobile satellite, GMPCS, and ISP as of 1998*	$= \sum_{i=1}^{n} \boldsymbol{licenses_n}$
Regulate prices	*Maximum regulatory agency statutory authority granted to determine and establish market prices and price caps for goods and services*	= max(***decision_authority***)
Determine market structure	*Maximum regulatory agency statutory authority granted to determine where firms enter (geographic regions of competition), with whom firms can enter (merger and acquisition approval), and what range of service firms must provide (universal access)*	= max(***decision_authority***)
Administer infrastructure	*Maximum regulatory agency statutory authority granted to determine and administer the infrastructure requirements of the industry, including telecommunications technical requirements, frequency planning, and numbering allocations*	= max(***decision_authority***)
Enforce consumer protection	*Maximum regulatory agency statutory authority granted to determine, enforce, and arbitrate consumer protection regulations*	= max(***decision_enforce_authority***)
Enforce economic regulations	*Maximum regulatory agency statutory authority granted to enforce economic regulations*	= max(***enforce_authority***)
Enforce antitrust rules	*Maximum regulatory agency statutory authority granted to enforce competitive antitrust regulations*	= max(***enforce_authority***)
Authorize mergers and acquisitions	*Regulatory agency statutory authority granted to authorize mergers and acquisitions in the telecommunications industry*	
Regulatory entry barriers	Dimension 2	
Restrict foreign ownership	*FDI regulations that limit foreign ownership in a given country*	Categorical variable
Average license duration	*Average number of years for which a telecommunications license is issued in a given country*	$= \sum \frac{\boldsymbol{years\_licensure}}{\boldsymbol{licenses}}$

Table 1 Continued

Variable	Definition	Calculation
Participate in WTO BTA (Basic Telecom Agreement)	*Country-level World Trade Organization level of participation in the Basic Telecom Agreement as a proxy for universal services globally*	Categorical variable
Require interconnectivity	*Statutory legal requirements, and technical and economic requirements, which obligate network operators to share physical assets that enable customers to connect across networks*	Categorical variable
Regulatory standards	Dimension 3	
Determine quality	*Maximum regulatory agency statutory authority granted to determine quality and performance standards*	
Determine subsidies	*Maximum regulatory agency statutory authority granted to administer subsidies and transfers*	= max(***decision_authority***)
Determine social considerations	*Maximum regulatory agency statutory authority granted to enforce social considerations*	= max(***enforce_authority***)
Enforce environmental regulations	*Maximum regulatory agency statutory authority granted to enforce environmental regulations*	= max(***enforce_authority***)
Enforce safety regulations	*Maximum regulatory agency statutory authority granted to enforce safety regulations*	= max(***enforce_authority***)
Regulatory stability	Dimension 4	
Agency interdependencies	*Number of regulatory agencies and constituent groups that are dependent on each other to impose and enforce compliance with the statutory laws*	= ***Σreg_agencies*** – ***independent_agencies***
Principal funding source(s)	*Primary source of funding for regulatory agencies responsible for enforcing compliance with regulatory statutory laws*	= max(***funding_type***)
Type of institution	*Highest level of institution authorized to enforce regulation, including presidential cabinet, government ministry, autonomous regulatory agency, trade association, or interest group*	= max(***regulatory_institution_type***)
Shifts in statutory law	*Dynamic measure of the number of shifts in regulation-related statutory laws generated from new laws created from executive orders, regulatory ordinances, or ministerial decrees or amendments to existing laws ex postmarket privatization*	$= \sum \frac{\boldsymbol{regulatory\_years}}{\boldsymbol{regulatory\_law\_shifts}}$; otherwise, 0

Table 1 Continued

Variable	Definition	Calculation
Shifts in regulatory structure	*Dynamic measure of the number of shifts in the regulatory infrastructure resulting from increased levels of privatization, changes in regulatory authorized bodies, and local market liberalization*	$= \frac{1}{\sum_{i=1960}^{1999} regulatory\_structure\_shifts}$
Regulatory political competition	Dimension 5	
Appointed term length	*Maximum number of years for each term a regulator can serve given his or her election or appointment*	Categorical variable
Reappointed term limits	*Maximum number of terms a regulator can serve in a regulatory position*	Categorical variable
Basis for appointments	*Political process for regulators' appointment to office, including public election, presidential or ministerial appointment, or self-appointment*	Categorical variable
Regulatory governance structure	Dimension 6	
Number of board members	*Number of regulatory board members appointed to the regulatory agency governing board*	$= \Sigma number\_board\_members$
Size of regulatory staff	*The number of regulatory staff employed by the regulatory agency*	$= \Sigma number\_staff$
Restriction of board member backgrounds	*Level of political network separation and ownership between the board members and the telecommunications industry constituents*	Categorical variable

FDI, foreign direct investment; GMPCS, global mobile personal communication by satellite; ISP, internet service provider.

size, and age of the agency, as well as detailed information on the political competitiveness in electing regulatory officials. Ten of the measures are derived from the NRAW reports. Lastly, the Telecoms Global Competitiveness Review (TGCR) is sourced to obtain information on the global entry barriers in telecommunications and market privatization in 40 of the countries. The remaining measures are derived from this source. The online appendix provides details on how each measure is coded. For countries not covered by Espicom Business Intelligence and TGCR – Telecoms, country-level regulatory agency websites, and the International Telecommunications Union regulatory reforms report (ITU 1999) are used to collect equivalent data. This data is a cross section of industry regulation in 1998. For future research in this vein, developing a dataset of panel data would be increasingly useful in understanding the institutional changes in regulation. This resides outside of the scope of this paper.

I use both inductive and deductive factor analysis techniques to explore and confirm the interrelatedness (McDonald 1985) between the specified measures of regulation. The goal of utilizing factor analysis techniques is threefold: (i) data reduction, (ii) validation of the dimensions, and (iii) scoring of the dimensions. First, I utilize PCA, an exploratory factor analysis

technique, to determine the level of communality among the 30 selected regulatory measures, as well as to further reduce the data so that I could focus on the factors that account for the majority of the variation of regulation across nations. I use both the Kaiser criterion (1964), which suggests a cut-off point for including factors with eigenvalues above 1.0, and the Scree test (Cattell 1966) to isolate the most efficient number of factors at the inflection point. Results from both tests indicate between five and six factors are most relevant (see online appendix, fig. A1 and table A9).

Next, confirmatory factor analysis is used to identify the common parts of the variables that uniquely explain the dimensional spaces of regulation. I compute the unrotated factor matrix, which codifies the factor loadings[3] for each variable on each column factor. These factor loadings represent the level of correlation each variable has to the factor and to what degree. I use a .40 factor loading cut-off as a minimal amount of explained variation for any variable's contribution to a factor (Rummel 1970).[4]

As a final step, I calculate factor scores for each dimension of regulation. For each firm, *i*, from country, *j*, the factor score matrix, X_{ij}, is derived by using a composite estimate approach (Cattell 1957), which sums the item scores of the most relevant variables for each dimension of regulation. The summative approach includes only those variable scores that have high loadings on the factor and near-zero loadings on other variables or straddling variables that have countersigns on other factors. This scoring matrix can be used to create comparative distance measures between regulatory environments.

3.1. Factor analysis results

Using factor analytic and principal component analysis data reduction techniques, these 30 variables are reduced down to six distinct dimensions of regulation (i.e. factors). These six dimensions are regulatory institutional stability, regulatory standards, governance structure, regulatory entry barriers, political appointment process, and competitive market structure. These results surprisingly reveal a counter-intuitive finding that factor one, regulatory institutional stability, accounts for the most variance in regulation, not the rules of the game. This factor accounts for 16 percent of the cross-national variation in industry regulation (see online appendix; table A9). The items that most strongly correlated with this factor are the *total number of regulatory bodies* (.88), *agency interdependence* (.66), *jurisdiction* (1.16), and *type of organization* (1.06).[5] The second-most-important dimension that explains 10 percent of the variation in cross-national industry regulation is *regulatory standards rules*. Items that most strongly correlated with factor two (2) are *quality regulations* (.46), *subsidies* (.72), *environmental regulations* (.62), *social consideration of providing service* (.43), and *safety regulations* (.91).

The third dimension, *governance structure*, explains nine percent of the variation in industry regulation. Factor three largely confirmed the most significantly correlated variable for governance structure to be *the board member restrictions, number of board members,* and *regulatory staff* variables, with loadings of .93, .97, and 1.01, respectively. Factor four, *regulatory entry barriers,* explains eight percent of the variation in industry regulation. All three items, *telecommunications foreign investment restrictions*, *WTO participation*, and *interconnectivity,* loaded onto this factor above the .40 criteria at .90, .57, and .46, respectively.

Factor five significant measures are all related to the *political appointment process*, including the items *reappointment limits* and *length of term* loaded heavily at .40 and .89, respectively. This factor explains six percent of the variation. Lastly, factor six – market structure rules – loaded most heavily by *regulate prices* (.45), *market structure* (.53), *consumer protection* (1.27), *antitrust rules* (.85), *regulatory responsibility for mergers and acquisitions* (.52), *economic regulations* (.55),

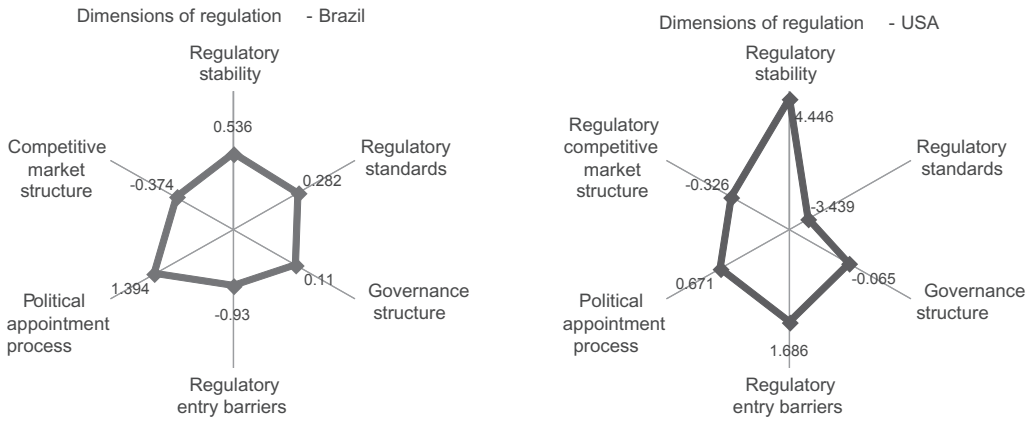

Figure 2 Cross-national comparative dimensions of industry regulation – Brazil versus USA.

and *enforcement of consumer protection* (.93). Surprisingly, this factor only accounted for six percent of the variation. Perhaps this is indicative of the mimetic and normative regulatory reforms that diffuse within industries rapidly (Henisz *et al.* 2005; Jordana & Levi-Faur 2005). If the diffusion of market structure rules is high, then little variance remains between country-level competitive rules. All six dimensions combined explain 55 percent of the industry regulatory variation.

Dimensional scores are generated by summing the items scores for each dimension. The variables that did not weight heavily on any of these factors were not included in the factor scores. This results in a scoring vector for each country *j*, such that:

$$X_j = \begin{pmatrix} competitive\_market\_structure\_rules_j \\ standards\_rules \\ entry\_barrier\_rules_j \\ political\_appointment\_process_j \\ governance\_structure_j \\ institutional\_stability_j \end{pmatrix} (6x1),$$

where $j = 1, 2, \ldots, n$ and n is the total number of countries. These dimensional score calculations by country are reported online.[6] Figure 2 clearly illustrates that the regulated space can vary dramatically between countries. For example, the strongest dimension of regulation in Brazil is the political appointment process of regulators; contrarily, regulatory institutional stability is the strongest regulatory dimension in the US.

These dimensional scores are compiled into a country-level industry regulatory measure, illustrated in Figure 3.[7]

4. Descriptive statistics

Figure 3 reveals that the US has by far the highest levels of industry regulation relative to all other countries examined. The regulatory score is nearly twice the level of regulation as the next highest regulated country, being Japan. The primary difference between these countries' regulatory environments is the dual layers of regulation at both the state and federal level.

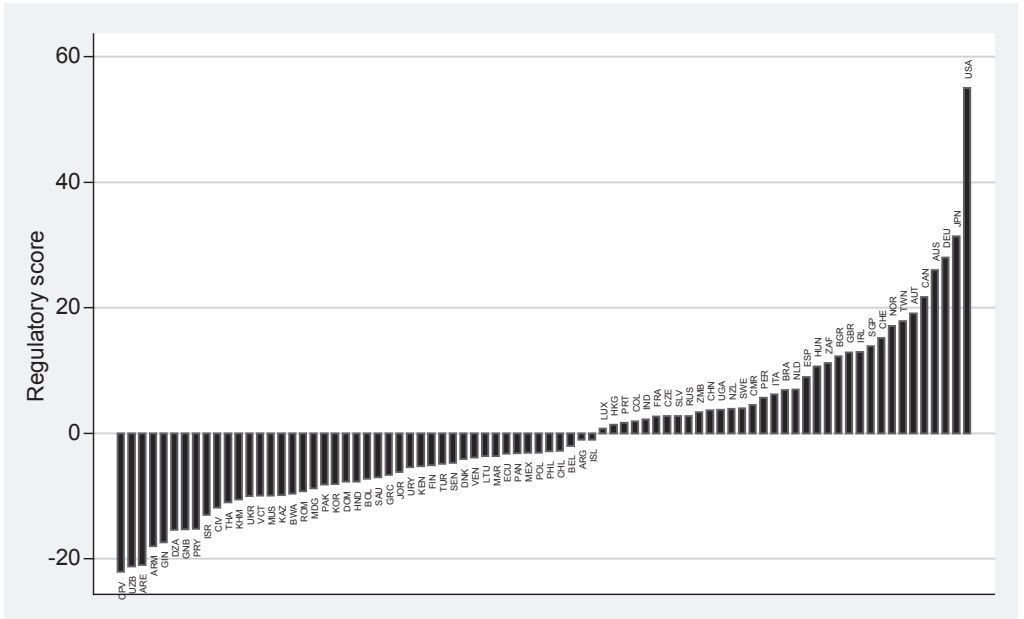

Figure 3 Telecom regulation by country.

Effectively, this means surpassing two regulatory licensure hurdles at both the FCC and the local municipal regulators. In comparison, other countries, such as Tanzania, Mali, and Angola, only require one license for the entire country. The country with the least industry regulation is Cape Verde. Descriptive statistics reveal that developed nations on average have higher industry regulation (in the telecommunications industry) than developing and LDCs with means of 5.8, −3.9, and −8.9, respectively (see Fig. 4 below). Means test results show significant differences between developing country and LDC regulations. This categorical difference translates to approximately 2.5 times the regulation and enforcement in developed countries versus LDCs. This data begs the question of whether stronger regulation is significantly correlated with market size. If so, which factors matter most? Figure 4 reveals (perhaps to no surprise) that the US is also the largest market size. This figure generally demonstrates that larger markets are associated with more regulation. In addition, the largest markets are in developed countries, rather than developing countries or LDCs.[8]

5. Conclusion and discussion

Prior studies on cross-national comparative industry regulation provided insight into comparative sources of variation in industry regulations, but lacked methodological approaches to quantify the variation between nations. This study provides a comprehensive framework to assess and evaluate industry regulation across nations. While existing theories on regulation characterize industry regulation largely as the laws related to market competition and correcting market imperfections, this study expands this view by introducing a new analytical approach using factor analysis to identify six dimensions of industry regulation that are most likely to vary between nations: (i) *competitive market structure rules*, (ii) *regulatory standards rules*, (iii) *entry barrier rules* which explain the statutory laws of regulation, (iv) *political appointment process,* and

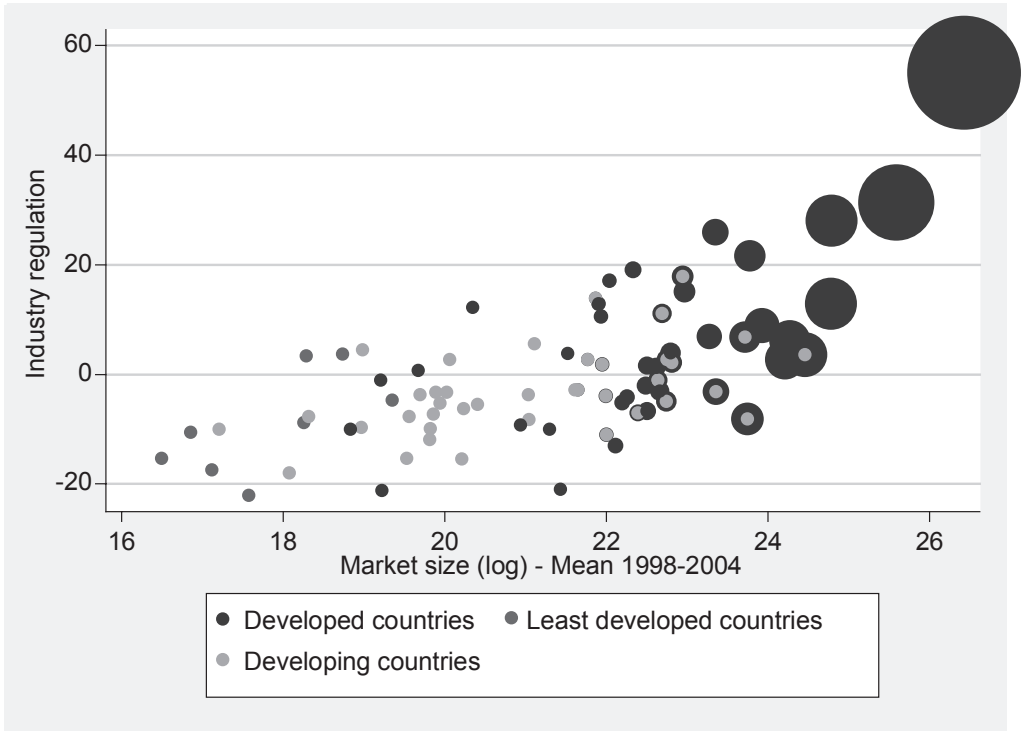

Figure 4 Standardized regulatory scores – mean of developed, developing and least developed countries. *Note*: Means tests (T-statistic) for standardized regulatory score for both developed versus developing countries and developed versus least developed countries is significant ($Pr(|T| > |t|) < 0.05$).

both (v) *governance structure,* corruption mitigating mechanisms of "good governments," and (vi) *institutional stability,* which captures the structural complexities of the regulatory institutions. These six dimensions account for 55 percent of the variation in industry regulation. Surprisingly, the most significant factor of variation in industry regulation is *institutional stability* of the regulatory agencies, which accounts for 16 percent of the variation. In contrast, the commonly theorized rules of the game of competition, *competitive market structure*, only accounts for six percent of the variation in industry regulation. Identifying and understanding the importance of each of these dimensions of regulation is key for scholars of regulation, policymakers, and foreign investment managers alike.

Another main finding of this research is that the US has the highest levels of industry regulation. More generally, developed nations have more industry regulations than their developing and least-developed country peers. This suggests that regulation is a key factor in the efficient functioning of markets. This fact is also particularly important for foreign investment managers to better understand the likely patterns of regulatory variation in the industry globally so as to be able to effectively adapt their strategies accordingly. For example, one potential pitfall for multinational firms that are from home countries with enforced interconnectivity regulation (e.g. US) is the inclination to overestimate the market potential in a country that does not regulate interconnectivity between competitors. The presumption that investments requiring significant capital expenditures will be shared cooperatively is not a market feature (nor is it reliably enforced) in many developing and least developed countries. In this sense, the lack of regulatory rules that facilitate and coordinate asset sharing agreements is a deterrent to entry

(e.g. entry barrier) for the less naive and more informed foreign firm. Multinational firms that understand these institutional constraints can better adapt their strategies in host countries with differing regulatory environments. Likewise, governments can be more efficient in designing regulatory institutions that improve the overall economic welfare of the country.

The aim of this research is to provide scholars, policymakers, and multinational firms with greater insight into the global impact of industry regulation. These regulatory dimensions help focus our research attention on the correlates of regulation that potentially shape industries the most. Though this paper operationalizes measures specific to the telecommunications industry, this regulatory framework can be easily applied to other regulated industries, such as gas, electric, mining, pharmaceuticals, or banking. Future research of this kind can use this data to explore the relationship between industry regulation and performance outcomes of sector growth, foreign trade patterns between nations, and firm performance. Future research can also further develop this cross-section of industry regulation into a panel of data on these 80 countries and beyond. For further details on data sources and methodological techniques, please see the online appendix.

Notes

1 The online appendix can be found at http://www.kellogg.northwestern.edu/faculty/directory/perkins_susan_e.aspx#research
2 Copies of the surveys are available upon request to the corresponding author.
3 Factor loading is defined as the weight for each factor dimension, which measures the variance contribution the factor makes to the data vector.
4 See the online appendix for further details of the factor analysis methodology.
5 See appendix table C2 for factor loadings.
6 These dimensional score calculations by country are reported in Table 2 online at the following web address: http://www.kellogg.northwestern.edu/faculty/perkins/publications/Table_2.pdf.
7 Note these scores are different than other demand driven variables, such as the number of subscribers or gross domestic product (GDP) per capita. The online supplemental materials provide such comparisons.
8 I provide a broad range of country comparisons covering 80 countries. I used the United Nations (UN) country status to codify developed countries, developing nations, and least developed countries (LDCs). In this sample, there are 33, 39, and 8 of each, respectively.

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