The instrumentalization of responsive regulation and its relative efficiency: experiences of the Brazilian National Telecommunications Agency

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Abstract

One of the regulator's primary responsibilities is to ensure regulatory compliance. In this arena, the responsive regulation technique stands out as a novel approach. This study has the dual goal of determining which and how efficient the responsive instruments in use in the Brazilian telecoms sector are. Empirical assessments are based on an inventory of the primary instruments in use at the Brazilian National Telecommunications Agency, and a Data Envelopment Analysis (DEA) method is used to evaluate their relative efficiency. The findings indicate that the Anatel employs a diverse variety of innately responsive instruments and instruments adapted to the responsiveness strategy. In turn, evidence from the efficiency evaluation indicates that the instruments have high scores. Some instruments lost relative power in some circumstances, which may indicate a tendency toward loss of efficiency over time. This study contributes to a comprehensive review of the regulatory strategy being implemented by Brazilian regulatory agencies.

Resumen

Una de las principales responsabilidades de un regulador es garantizar el cumplimiento normativo. En este ámbito, las técnicas de regulación responsiva (responsive regulation) destacan como un enfoque novedoso. El presente estudio tiene dos objetivos: determinar cuáles y qué eficientes son los instrumentos responsivos en uso por el sector de telecomunicaciones brasileño. Las valoraciones empíricas se basan en un inventario de instrumentos primarios utilizados por la Agencia Nacional de Telecomunicaciones de Brasil (Anatel), y el método de Análisis Envolvente de Datos (Data Envelopment Analysis – DEA) es utilizado para evaluar su eficiencia relativa. Los hallazgos indican que Anatel emplea una variedad diversa de instrumentos inherentemente responsivos e instrumentos adaptados a la estrategia responsiva. A su vez, la evidencia de la evaluación de eficiencia indica que los instrumentos tienen altos puntajes. Algunos instrumentos perdieron poder relativo en algunos casos, lo cual puede indicar una tendencia hacia la pérdida de eficiencia en el tiempo. Este estudio contribuye a una revisión completa de la estrategia regulatoria implementada por las agencias regulatorias en Brasil.

Resumo

Uma das principais responsabilidades de um órgão regulador é garantir a conformidade regulatória. Nessa área, as técnicas de regulamentação responsiva se destacam como uma nova abordagem. Este estudo tem dois objetivos: determinar quais são e quão eficientes são os instrumentos responsivos em uso pelo setor de telecomunicações brasileiro. As avaliações empíricas baseiam-se em um inventário de instrumentos primários usados pela Agência Nacional de Telecomunicações (Anatel), e o método de Análise de Envoltória de Dados (DEA) é usado para avaliar sua eficiência relativa. Os resultados indicam que a Anatel emprega uma gama diversificada de instrumentos inerentemente responsivos e instrumentos adaptados à estratégia responsiva. Por sua vez, as evidências da avaliação de eficiência indicam que os instrumentos têm pontuações altas. Alguns instrumentos perderam poder relativo em alguns casos, o que pode indicar uma tendência de perda de eficiência ao longo do tempo. Este estudo contribui para uma análise abrangente da estratégia regulatória implementada pelas agências reguladoras no Brasil.

1. Introduction

One of the key pillars of regulatory intervention is ensuring compliance by regulated entities. Traditionally, this is achieved through a command-and-control strategy, which relies heavily on enforcement tools to address rule violations.

From this standpoint, regulators define the expected behavior and create monitoring and sanctioning frameworks to enforce compliance, often imposing financial penalties on the

regulated sector to ensure adherence to norms. This approach can lead to a climate of ongoing litigation and increased monitoring costs, affecting both government and regulated entities.

In this landscape, responsive regulation emerges as a significant innovation in state regulation strategy. Although its theoretical foundation has solidified over the past two decades, the practical mechanisms—how regulators interact with regulated parties to encourage compliance—remain less understood. This research delves into the 'instrumentalization' of responsive regulation.

The study evaluates the efficiency of the primary instruments of responsive regulation currently in use in Brazil. It aims to provide a comprehensive review of these instruments, their scope, and intended outcomes. Efficiency is assessed using the Data Envelopment Analysis (DEA) method. The empirical analysis focuses on the National Telecommunications Agency (Anatel) as a case study, chosen for its advanced implementation of responsive regulation and the diverse instruments in its portfolio (ANATEL, 2015; 2019a).

The remainder of this article is organized into four sections. The next section briefly reviews the theoretical underpinnings of responsive regulation and its application in Brazil. The 'Methods and Data' section outlines the instruments' scope and the methodology for evaluating their effectiveness. The 'Results' section presents the efficiency scores of these instruments. Finally, the 'Conclusions' section highlights the study's key findings and considerations for instrument design.

2.Regulation, responsibility and the design of responsive regulatory intervention instruments

The traditional regulatory framework is a result of economic liberalization policies that aimed to transfer the provision of essential public services to private firms. Regulatory bodies play a crucial role as institutions that promote efficiency in service delivery by using mechanisms to incentive competition and by monitoring service quality, universalization, and customer care.

The public choice theory served as a fundamental theoretical foundation for the design of regulatory agencies. Pioneers in the regulatory branch of public choice theory, such as Stigler (1971) and Niskanen (1998), have contributed to designing regulatory models and the establishment of clear boundaries between the state and the private actors.

Several other theories have also played a significant role in shaping the regulatory environment. For example, the coercion methods, derived from the legal theories of punitive regulation, whose elaboration is based on the search for mutual understanding manifested in the balance between coercion (enforcement) and compliance with the norm (compliance) (ARANHA, 2019) are commonly employed within the command-and-control framework.

The theory of responsive regulation arose as a countermeasure to the calls for deregulation

and self-regulation by both the state and private sectors during the 1970s. Since its inception, the theory has evolved to embody the obstacles posed by deregulated markets, liberalization initiatives, and their requirements for transparency. Hence, it has been established as a forum for epistemic dialogue between opposing perspectives of heightened government intervention and deregulation.

Braithwaite (1982, 1985, 2002, 2006, 2007) is credited with leading the development of current approaches to responsive regulation. One of his core arguments is that a negotiated relationship between the regulator and the regulated entities yields greater benefits than strategies focused solely on maximizing individual welfare. Braithwaite posits that fostering an incentive-based culture within the regulatory framework can promote more ethical and collaborative behavior, leading to enhanced compliance standards.

The topic of responsive regulation has been extensively studied in Brazil, with several authors exploring its advantages, limitations, and applicability in the institutional-legal context of the country. Among the main themes addressed are the balance between instruments of persuasion and punishment, the level of autonomy granted to regulated agents, and the potential and challenges of this approach in the Brazilian regulatory framework. Some of the authors who have contributed to this research area include Aranha (2016, 2018, 2019), Thorstensen and Arima Junior (2020), and Casotti (2021).

The implementation of responsive regulation by regulatory bodies in Brazil has been a significant factor in the advancement of research in this field. Several studies have provided evidence of the inadequacy of the traditional command and control approach, resulting in a persistent subculture of conflict between regulators and regulated agents, which had led to implications for mutual trust. Studies have identified issues such as the high costs associated with inspection activities (ALVES; PECI, 2011), the deliberate decision of noncompliance due to punitive costs (UHR; UHR, 2014), excessive burdens placed on regulators to implement command and control practices (BLANCHET; BUBNIAK, 2017), lack of incentives for private parties to comply (LACERDA; THOMAS, 2019), and inefficiency of sanctioning instruments (TCU, 2006, 2017; SILVA, 2017; FONSECA, 2019).

The adoption of responsive regulation was speeded up during the COVID-19 crises following recommendations by international organizations. For instance, the International Telecommunication Union (ITU) 2021 Best Practice Guidelines highlighted the need for agile, responsive regulatory action and leadership to foster investment gaps and scarce available funding for digital infrastructure and services (ITU, 2021). The success of this regulatory approach is also subsidizing the way the State is regulating new services in the Digital Markets realm. Reports for these new markets state that in the absence of a hierarchy of enforcement methods, an approach based on responsive regulation should be preferable and it relies on assuming that gatekeepers wish to comply and that third parties have a voice in shaping that compliance effort. This means that greater recourse is made to the supervisory measures than to the punitive measures (CERRE, 2024).

In this context, the promotion of responsive regulation as a viable alternative to the traditional command and control approach has gained traction in Brazil. Arrangements in the form of regulatory pyramids flourished in the 2000s governed by guidelines on the hierarchy of sanctions and degrees of intervention, governance, and limits of mutual trust. This multidimensional chain allowed for a rebalancing of the roles of regulators and regulated actors towards norm compliance.

It is important to acknowledge that responsive regulation represents a significant breakthrough in the regulatory landscape, building upon and incorporating earlier models. Rather than being a complete departure from traditional strategies, it involves a regulatory approach that seeks to balance punishment and persuasion and utilizes incentive mechanisms to grant greater autonomy to regulated entities, encouraging them to comply with regulatory objectives. As Ayres and Braithwaite (1992) define it, responsive regulation establishes a constructive collaboration between punishment and persuasion through a focus on incentives.

2.1 Instrumentalization of responsive regulation

The instruments utilized in responsive regulation emerge from both theoretical discussions and the actual regulatory practice, influenced by the technical-legal context and the specificities of regulated sectors being regulated. They are developed within this multi-layered framework, with the aim of influencing the behavior of regulated agents towards regulatory goals (HEIJDEN, 2020). Gunningham and Grabosky (1998) underscore the importance of effective instruments in their theory of smart regulation, highlighting the role a repertoire of techniques and tools play as critical mechanisms for the success of regulatory strategies.

Kolieb's (2015) approach emphasizes the importance of analyzing the relationship between instruments, strategies, and compliance. The author's "regulatory diamond" diagram adds elements of incentive to the components of constraint to enable the design of mechanisms that go beyond normative compliance (beyond compliance). It aims to replace the cumbersome responses (sanctions) to specific behaviors (violations).

It is noteworthy that Anatel's adoption of responsive regulation principles aligns with global trends in regulatory practices. Many regulatory agencies around the world have been exploring and implementing responsive regulation to promote compliance and achieve regulatory goals more effectively. Anatel's efforts in this regard demonstrate its commitment to improving regulatory outcomes in Brazil and ensuring that its regulatory activities are more efficient and effective. To reach the current level of maturity the Agency invested in an in-depth acculturation process that included the commissioning of applied studies, adaptation of the routines, and extensive training sessions (ANATEL, 2015, 2019a; ANAC, 2020). The institutionalization of responsive regulation was accomplished through the issuance of a resolution (ANATEL, 2021f) that has a comprehensive scope encompassing

all facets of Anatel's regulatory activities.

Following its initial efforts to develop a responsive regulatory approach, Anatel has been at the forefront of creating various regulatory instruments. The following table summarizes an inventory of the main responsive instruments in use by the Agency.

Table 1: Responsive regulation instruments in the Brazilian telecommunications sector (in chronological order)

Instrument	First application	Main objective	Nature	Geographical counterpart	Effect
Reserved space on the companies' website	03/2015	Transparency	*ex-ante*	National	Specific
Serviços Adicionais (SVA)	08/2018	Transparency	*ex-ante*	National	Specific
Programa de Cancelamento Automático	12/2018	One-click solution to consumers	*ex-ante*	National	Specific
Ranking de Acessibilidade	03/2019	Accessibility	*ex-ante*	National	Specific
Pay or Play (Sanção de Obrigação de Fazer (OdF))	04/2019	*Compliance*	*ex post*	Local	Diffuse
*"Não me perturbe"**	07/2019	Telemarketing	*ex-ante*	National	Specific
Concurso Prática Inovadora nas Relações de Consumo	11/2019	Consumers experience	*ex-ante*	National	Specific
Termo de Ajustamento de Conduta (TAC)	09/2020	*Compliance*	*ex post*	Local	Diffuse

Note: * The 'do not disturb me' instrument is part of the self-regulation spectrum. The inventory of instruments and the respective characterizations were carried out by the authors based on references available at ANATEL (2016a, 2016b, 2017, 2019b, 2019c, 2019d, 2019e, 2020b, 2020c, 2020f).

The categorization of responsive instruments into preventive and corrective types is based on their focus on *ex ante* or *ex post* actions, respectively. Preventive instruments are designed to encourage compliance before a rule violation occurs, while corrective instruments are intended to address non-compliance after a regulatory violation has taken place. Incentives and dialogue with the regulated sector are notable features of responsive instruments. The inventory suggests that their design often involves targeted actions that primarily influence the regulated entities' interactions with users.

Punitive and pedagogical approach characterizes *ex post* instruments. Its incentives are based on promoting the recognition of the infraction by the regulated and on adopting expeditious measures to repair the consumer and improve service provision. In addition, these instruments seek to ensure autonomy to the regulator in the pursuit of greater adherence to the rules by the regulated agents and in the imposition of corrective constraint mechanisms.

The first born-responsive instrument set up by Anatel refers to the "Reserved Space" functionality on service providers´ websites. This instrument was implemented during the pilot stages of the responsiveness discussion within the Agency when the regulator and service providers collaborated to establish transparency rules. The Reserved Space provides a simple and up-to-date solution for customers to access their billing and consumption data with just one click.

Another *ex-ante* responsive instrument implemented by Anatel is 'Additional Services,' which aims to enhance transparency in the contracting of value-added services (VAS). Its conception was experimental and developed within a negotiated context, in response to a considerable number of complaints about the offering and undue charges associated with VAS (ANATEL, 2017a). The instrument establishes a double opt-in procedure, requiring the service provider to confirm the user's willingness to use the service before activation, thereby mitigating fraud, inappropriate sales, omissions, and undue charges.

The instrument known as "automatic cancellation" aims to provide users with the ability to cancel services without the intervention of customer service personnel, thus preventing service providers from engaging in abusive customer retention practices. This instrument was developed through a dialogue with service providers during a time when the concept and application of such instruments were being consolidated (CONEXIS, 2020).

The 'Accessibility Ranking' was the first instrument developed by Anatel with the goal of incentivizing improvements in services for users with disabilities through specific

communication tools. It originated from the General Accessibility Regulation, which was approved by Resolution 667/2016 (ANATEL, 2016a). The ranking is compiled following a detailed procedure (ANATEL, 2016b, 2020f), the terms of which define the variables and methodologies used to rank the most accessibility-friendly providers. Currently in its third annual edition, the Accessibility Ranking, similar to the 'Contest for Innovative Practice in Consumer Relations,' aims to foster a spirit of positive competition among the leading providers in the sector.

The 'pay-or-play' (also known as 'obligation-to-do') sanction is an ex-post instrument applied to regulated parties who have committed an administrative infraction. It allows sanctioned service providers the option to undertake compensatory actions through investment obligations instead of paying a monetary penalty. These obligations must be fulfilled in predetermined locations with low economic attractiveness, particularly in rural and peripheral regions (Freitas et al., 2019). This instrument was developed within the framework of responsive regulation and was initially implemented on an experimental basis in 2019, with the pilot program concluding in 2020 (ANATEL, 2020c). The costs of infrastructure and its maintenance are determined by the regulator, and any surpluses resulting from efficient implementation are retained by the regulated entity, which reflects one of the instrument's incentives (ANATEL, 2020a).

The 'Do Not Disturb Me' instrument was developed to address the issue of excessive telemarketing calls. It gained public awareness in the context of chronic harassment experienced by users from telemarketing service providers. According to ANATEL public records, between January 2016 and June 2019, there were 86,493 complaints related to unwanted calls (ANATEL, 2019d), a historical record. The 'Do Not Disturb Me' instrument operates on the premise that customers must actively request to not receive telemarketing offers by completing an electronic registration form provided by a telecommunications services providers consortium. This registry serves as a basis for programming the sector's telemarketing activities, acting as a filter to prevent unwanted contacts related to the offer of telecommunications services. The instrument was conceived outside the traditional regulatory framework and introduced self-regulation principles as an innovation in the spectrum of responsiveness (Braithwaite, 2011). Service providers have voluntarily committed to adhering to the instrument and have adapted their policies to promote its effectiveness. This commitment is reflected in a public code of conduct that has been endorsed by the largest companies in the sector (CONEXIS, 2020)..

The so-called 'Service Quality Contest' is an award program that recognizes innovative practices in consumer care programs, designed to promote consumer welfare. This initiative provides incentives for service providers to develop creative service solutions. In practice, the instrument aimed to create a positive effect on the performance of service providers that demonstrated effective results in enhancing the quality of their services to end users. As a result, these providers would be granted authorization to use this recognition in their marketing campaigns. Measurable performance benchmarks and detailed identification of

implementation phases were among the prerequisites for participation in the contest (ANATEL, 2019c). Regarding the evaluation criteria, it included guidelines related to the solution, scope, results, and long-term commitment.

The Term of Adjustment of Conduct (TAC) is another pioneering instrument within the scope of the responsive *ex post* approach. Its origins can be traced back to Law 7,347/1985 (BRASIL, 1985) and it was incorporated into Anatel's regulatory framework through the Regulation for the Application of Administrative Sanctions (ANATEL, 2012). Subsequently, it was subject to specific regulation under Resolution 629/2013 (ANATEL, 2013), which approved the Regulation for the execution and monitoring of TAC. The instrument is characterized by a negotiation-based approach that involves rectifying previously identified nonconformities and adopting additional commitments to enhance service quality for users, as well as making necessary investments (ANATEL, 2013).

In June 2020, the first TAC was signed in accordance with Resolution 629/2013, aimed at adjusting the conduct related to the macro-themes of "Quality", "Extended Access", "User Rights and Guarantees" and "Inspection". (ANATEL, 2020d). In the same year, a second TAC was held (ANATEL, 2020e), which covered conduct related to the "Quality" macro-theme. The commitments made, along with additional investments resulting from the TACs, amount to more than R$ 415 million. These commitments pertain to targets for providing infrastructure for the operation of mobile services in 4G technology, expanding the fiber optic network to underserved areas, and increasing infrastructure density in economically less attractive locations, primarily in the North and Northeast regions (ANATEL, 2020d).In addition to the instruments listed above, Anatel is developing several others. This multitude of initiatives reveals the innovative potential of the responsive strategy.

3. Methodology and data

The historical application of responsive instruments has resulted in a robust dataset, which enables both qualitative and quantitative assessments of their collective and individual performance. At this point, this research introduces the empirical question of measuring the efficiency of these instruments. This approach falls under the branch of production economic research and represents a restricted optimization problem in which agents optimize their objectives subject to the restrictions imposed by the available technology.

In summary, it aims to appraise whether the observed performance is consistent with the optimized standards and then quantify the optimization deviations (i.e., inefficiencies). For the purposes of this study, the relative performance of the responsive instruments is settled on a non-parametric method referred to as Data Envelopment Analysis (DEA), as defined by Charnes et al., (1978), Banker et al. (1984) and Coelli et al. (1998) and with extensive use in Brazilian regulated sectors (BRAGANÇA; CAMACHO, 2012; AZEVEDO et al., 2012; FREITAS et al., 2016; FERNANDES; RESENDE FILHO, 2018). The DEA has a comparative advantage towards parametric approaches since it does not require assumptions on

technology specifications, nor strong hypothesis about the performance of responsive instruments in the field of regulation.

DEA is based on a production function in which inputs are combined to produce outputs. This production function represents the technical efficiency frontier, which serves as a benchmark for measuring the relative efficiency of Decision-Making Units (DMUs), considered in this study as individual responsive instruments. In this model, the algebraic distance between an individual observation and the efficiency frontier is the measure of efficiency. In summary, the DEA model designed for this research posits that a DMU aims to minimize the number of complaints recorded in Anatel's service channels (undesirable outputs). Thus, it is an output-oriented framework where the results are interpreted as the proportion by which outputs can vary while input levels remain constant. Further details on the setting up of the DEA model are provided below.

3.1. Data base

Prior to outlining the model specification, it is imperative to introduce the set of input and output data and references. The model specification relies on two inputs and one output. The inputs are the cost, in Reais (R$), of handling complaints registered on Anatel's service channels, and the time, per day, for processing these records, from their inclusion to effective closure. In turn, the output is represented by the number of recorded complaints registered on the various Anatel service channels.

Table 2: Databases and their sources

Variable	Unit	Type	Data Source
Number of Complaints in Anatel's Service Channels	Complete Complaints	Output	ANATEL (2021d)
Average response time for complaints	Days	Input	ANATEL (2021d)
Average Service Cost per registration at Anatel's Call Center*	R$	Input	ANATEL (2019d)

Notes: authors, based on public data (ANATEL, 2021c, e, f).

The output corresponds to consumer complaints logged on Anatel's service channels. A

semantic association procedure was used to assign the reviewed complaint records to a regulatory instrument. This consisted of a systematic review of the complaint text summaries using a set of predefined keywords. Such a procedure enabled the association of 27% of the 21.2 million complaint records available from January 2015 to March 2021 with the instruments listed in this study. Complaints that could not be associated were removed from the dataset. The following table summarizes the distribution of total registrations, by input channel and by year.

Table 3: Record of user complaints by type of service channel (ANATEL)

Customer service channels	2015	2016	2017	2018	2019	2020	2021
Call Center	64,8%	66,6%	63,5%	59,9%	56,1%	41,5%	40,4%
Contact us	31,7%	26,7%	27,7%	29,9%	26,6%	–	–
WEB User	–	–	–	–	4,2%	36,6%	36,4%
Mobile based Form	2,8%	6,3%	8,5%	9,9%	10,7%	–	–
App	–	–	–	–	2,2%	21,9%	23,1%
Others	0,7%	0,4%	0,4%	0,3%	0,3%	0,0%	0,0%

Note: prepared by the authors based on public data (ANATEL, 2021b). The distribution of registrations takes place according to the schedule of entry into force of the channel and its respective end.

As for inputs, the cost of treating it refers to the unitary cost of R$ 3,71 per registered complaint (ANATEL, 2019d). Notwithstanding this reference is only available for treated complaints received on the call center channel, it is assumed for this study as a proxy reference for complaints cost. The effective service time refers to the number of days

between the date of the complaint registration and its resolution. Table 4, below, summarizes the average number of days to respond to the complaint records object of the responsive instruments.

Table 4: Average days for handling complaints associated with the instruments

Instrument	**Main associated complaint***	**Average number of days to resolve complaints**
Do not disturb me	“Inconvenient and persistent calls ”	8,34
Contest Innovative Practice	“Unavailability of human attendant”	7,08
Reserved Space on the companies’ portal	“Non-receipt of corrected bill or debit installment”	6,85
Additional Service Project (SVA)	“Charging for additional services not contracted”	6,52
Accessibility Ranking	“Accessibility to Services”	6,80

Note: prepared by the authors based on public data (ANATEL, 2021d).

It should be noted that the highlighted period corresponds only to the complaints records successfully resolved.

3.2. The design of the DEA model

The DEA model chosen for this study corresponds to the standard approach between the nonparametric methods. It is settled on a deterministic algorithm framework that calculates the efficient frontier through linear approximations based on a set of DMUs´ performance.

The DMUs correspond to a composition of responsive instruments features. It embodies the individual responsive instrument, year and month of the complaint. The following table illustrates the systematic composition of the DMUs adopted for this study.

Table 5: Systematic composition of decision-making units (DMU)

Responsive instrument	**Year**	**Month**	**DMU*i***
1. 'Do Not Disturb Me'	2020	01	DMU1
…			
n. "Contest Innovative Practice in Consumer Relations	2019	04	DMUn
…	…		…

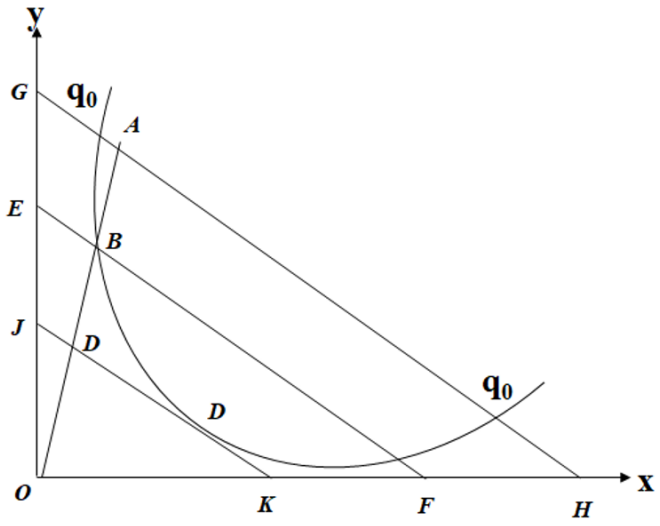
Notes: elaborated by the authors (2022).

This compositional technique aims to ensure consistency in the analysis by expanding the sample base of Decision-Making Units (DMUs). The technique adheres to the best practices proposed by Angulo-Meza et al. (2005) and is also employed by Anatel in its estimation of the x-factor for the annual adjustment of fixed telephony tariff prices (ANATEL, 2017b). Consequently, each instrument within each time is considered an independent DMU. Furthermore, the DMU framework facilitates the assessment of the historical performance of responsive regulation instruments.

Given the heterogeneous set of instruments with varying degrees of regulatory maturity, the DEA model is designed to accommodate variable returns to scale. This ensures that the DMUs are evaluated on a comparable basis. In this model, efficiency is interpreted as a relative measure and varies between 0 and 1 (score). The closer to the efficiency frontier the DMUi is the better its relative performance. A scalar equal to 1 indicates that DMUi is in the efficiency frontier, and, in this condition, it displays maximum relative efficiency (FARREL, 1957). The projection of the efficiency frontier and the relative position of each DMUi are calculated with linear programming set up in this study with the objective of minimizing the number of complaint records for each and sample instruments.

The objective function represents the allocative efficiency of inputs, that is, all inputs should be multiplied to obtain returns that place the DMUi on the efficient frontier. The model constraints define that the inputs are bounded by the level of the efficient DMUs and that the reduction of inputs does not change the current level of DMU outputs. This set up is then a typical cost efficiency model in which the instrument engenders allocative efficiency and technical efficiency (BANKER et al., 1984). It is represented as follow:

Figure 1: Conceptual representation of the problem of minimizing complaints (undesirable outputs) and the relative efficiency of DMUs



Notes: elaborated by the authors (2022).

In algebraic terms, the allocative efficiency is represented by the relative distance between B and D, calculated by the ratio:

$$0 \leq \frac{d(O,D)}{d(O,B)} \leq 1$$

In turn, technical efficiency is measured by the ratio:

$$0 \leq \frac{d(O,B)}{d(O,A)} \leq 1$$

The returns to scale of the chosen results are important definition for the purposes of this study and have effects on the model designing. The model that best fits the case under study is the one proposed by Banker, Charnes and Cooper (1978) (BCC model), which defines efficiency as a variable return to scale (VRS) and non-proportionality between inputs and outputs. This option is justified by the diversity of the responsive instruments shown in the sample, given the distinct types of complaints they wish to address.

According to the BCC model, the efficiency θ* of a given DMUi is reached by applying the

following optimization model:

$$\theta^{*} = min\theta$$

$$\text{s.t.}$$

$$\sum_{j=1}^{n} x_{ij}\lambda_{i} \leq x_{0}$$

$$\sum_{j=1}^{n} y_{rj}\lambda_{i} \geq \theta y_{r0}$$

$$\lambda_{j} \geq 0 \forall \lambda_{j}$$

Where θ is a scalar of the BCC model and λn is a Nx1 vector of constants. If θ* = 1, the DMU is considered efficient or a benchmark, however if θ*< 1, the DMU is relatively less efficient or performs worse than others DMUs in the sample. As restrictions parameter the xji refers to the quantity of input j used by DMUi and yri is the quantity of outputs r for the DMUi.

4. Results

The following table presents the frequency distribution of the DEA score for the DMUs. As stated in the methodology section, scores 1 indicate that the instrument's efficiency is positioned at the efficiency frontier. In turn, the further away from 1, the instrument reveals a lower relative efficiency.

Table 6: Efficiency score of responsive regulation instruments

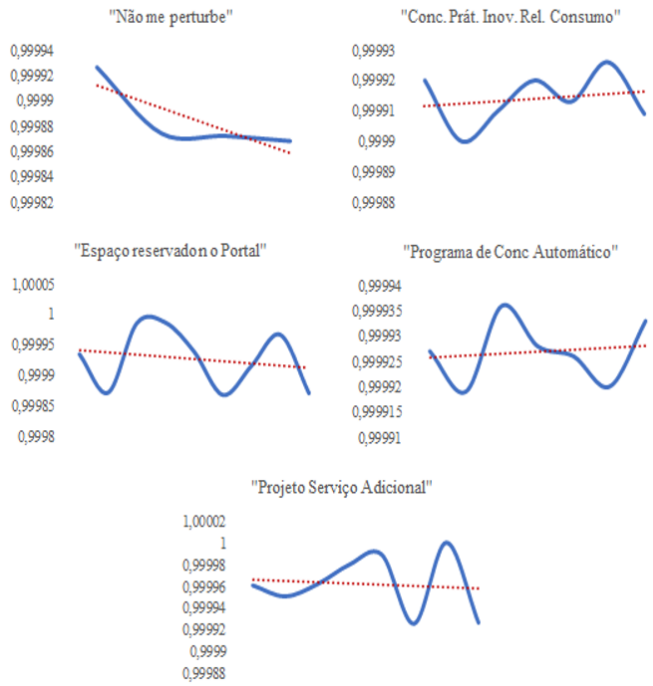
DMU	Month/Year	Efficiency Score	DMU	Month/Year	Efficiency Score
DMU1	01/2020	0,999927	DMU21	04/2018	0,9999
DMU2	04/2020	0,999875	DMU22	08/2018	0,999942
DMU3	08/2020	0,999873	DMU23	01/2019	0,999905
DMU4	01/2021	0,999869	DMU24	04/2019	0,999923
DMU5	01/2019	0,99992	DMU25	08/2019	0,999873
DMU6	04/2019	0,9999	DMU26	01/2019	0,999927
DMU7	08/2019	0,99991	DMU27	04/2019	0,999919
DMU8	01/2020	0,99992	DMU28	08/2019	0,999936
DMU9	04/2020	0,999913	DMU29	01/2020	0,999928
DMU10	08/2020	0,999926	DMU30	04/2020	0,999926
DMU11	01/2021	0,999909	DMU31	08/2020	0,99992
DMU12	04/2015	0,999935	DMU32	01/2021	0,999933
DMU13	08/2015	0,999872	DMU33	08/2018	0,999961
DMU14	01/2016	0,999986	DMU34	01/2019	0,999951
DMU15	04/2016	0,999987	DMU35	04/2019	0,999962
DMU16	08/2016	0,999939	DMU36	08/2019	0,99998
DMU17	01/2017	0,999868	DMU37	01/2020	0,999989
DMU18	04/2017	0,999916	DMU38	04/2020	0,999926
DMU19	08/2017	0,999967	DMU39	08/2020	1
DMU20	01/2018	0,999871	DMU40	01/2021	0,999927

Notes: DMU1-DMU4: “Do not disturb me”; DMU5-DMU11: “Contest Innovative Practice in Consumer Relations”; DMU12-DMU25: “Reserved Space on the Companies Portal”; DMU26-DMU32: “Automatic and Automated Cancellation Program”; DMU33-DMU40: “Additional Service Project (SVA)”. SIAD software v.2.0 (ANGULO-MEZA et al., 2005)was used for algebraic processing purposes.

Results indicate that the majority of DMUs exhibit high efficiency. This observation implies the overall effectiveness of the design and implementation of responsive regulation instruments by the telecommunications regulator. In essence, it suggests that, collectively, the instruments operate near the optimization curve, thereby possessing the capacity to achieve the regulatory objectives.

Figure 2 summarizes the dynamic performance of the DMUs. The varied patterns illustrate the reactions of consumers and service providers to the regulatory instruments over time. Instruments exhibiting an upward trend indicate a maturation towards improved performance and, consequently, greater adherence to regulatory objectives. Conversely, downward trends signal a diminishing effectiveness of the instruments over time.

Figure 2: Visualization of the scores of the studied DMUs



Notes: Red dotted line refers to the linear trend curve.

Source: Elaborated by the authors, based on the scores of the DMUs, obtained with the application of the DEA-BCC model (2022).

Unexpected downward trends reveal a pattern still unexplored in the literature of responsive instruments. In short, it demonstrates that some instruments loose relative efficiency over time and some of them as is the case of ‘Do Not Disturb Me’ also referred to as ‘Não Me Perturbe’ suggest that the instrument has not reach any positive effect (less complaints) over the assessed period.

These erratic trend phenomena may indicate potential rebound effects, characterized by a tendency to revert to the pre-intervention state, or, as in the case of the 'Do Not Disturb Me' initiative, a gradual decline in the instrument's effectiveness over time. This could be due to several factors, such as reduced compliance by service providers, the instrument's inability to achieve its intended purpose, or the sector's deliberate efforts to find alternative methods to maintain its practices, among other factors.

As a matter of simplification, it is worth taking the 'Do Not Disturb Me' initiative as a reference for analysis. Regarding its effectiveness, it should be noted that it was not a mandatory measure for data centers or for callers outside the telecommunications or finance industries, which may have expanded during the sampling period. Additionally, some companies might have ceased compliance because it conflicted with business models associated with active data center operations. Furthermore, the introduction of the initiative increased public awareness of the issue, inadvertently leading to a rise in the number of complaints.

Recognizing the initiative's limited success, Anatel later announced a review to broaden its scope and enhance its effectiveness (ANATEL, 2021a; 2021d,e). The steps taken by the regulator highlight the importance of assigning an evolutionary character component to the responsive instruments, including the possibility of updating the governance mechanisms to meet the dynamics of the market. Further steps would include 'coordinated intersectoral efforts as the active call centers business model are intensive used beyond Anatel's competences, which did not occur in the original design of the instrument.

Regardless of the determinants that lead to an eventual reduction in the scores of some DMUs, preliminary evidence on the loss of instrument power reveals a new input for a review of the tactical aspect of responsive regulation approach. Also, a single responsive regulation instrument may not be enough to achieve all the intended benefits eventually requiring the use of different instruments that are tailored to the level of compliance of the regulated entities.

5. Conclusions

This study presents an inventory of responsive regulation instruments implemented by the Brazilian telecommunications regulator, Anatel, and evaluates their relative efficiency. The inventory highlights instruments designed to improve the regulatory compliance of telecommunications service providers, covering aspects such as transparency, accessibility, and adherence to rules, as well as enhancing consumer experiences. It also differentiates between the instruments' preventive and mitigatory features.

The performance assessment involves analyzing the relative efficiency of the responsive instruments using Data Envelopment Analysis (DEA), a nonparametric method for estimating efficiency frontiers. This analysis may represent the first quantitative evaluation of its kind in the Brazilian context.

The findings indicate that, overall, responsive regulation instruments achieve high efficiency scores and have a positive impact on reducing the number of consumer complaints, which is considered an undesirable output in the model. The study also reveals that certain instruments experience a decline in relative efficiency over time, highlighting the potential for these instruments to become less effective and the necessity for their dynamic review to maintain relevance with market trends.

A key focus is the 'Do Not Disturb Me' instrument, developed to address the issue of excessive telemarketing calls, which at the time of the research was a significant source of consumer complaints. The results show a systematic decrease in efficiency following the instrument's implementation, indicating potential flaws in the instrument's design and the market's response to the costs imposed by the instrument. This decrease in efficiency was later confirmed by the regulator. Such findings underscore the method's potential to provide timely updates on the results throughout the implementation of the instrument.

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