

STI policies in the Dominican Republic: the influence of economic rationales from a context-development perspective

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Abstract

This article examines the influence of different economic rationales in the Dominican Republic's science, technology, and innovation (STI) policies from a context-development perspective. For this purpose, four STI policy frameworks are reviewed: the National Competitiveness Plan; the Strategic Plan of Science, Technology, and Innovation; the Ten-year Plan of Higher Education; and the National Development Strategy 2030. Three cycles of STI policies are covered: the industrialization and import substitution cycle; the structural adjustment cycle; and the post-structural adjustment cycle. Five economic rationales are considered: neoclassical, Schumpeterian growth, neo-Marshallian, systemic-institutional, and evolutionary thought. Based on the results, three rationales prevail: a systemic-institutional approach; a neo-Marshallian perspective; and a Schumpeterian growth approach. These rationales may refer to the country's challenges to spur its potential for economic growth and development.

Key words: science policy; technology and innovation policy; policy rationales; context development perspective; developing countries; Dominican Republic

1. Introduction

This article examines the influence of different economic rationales in the Dominican Republic (DR)'s science, technology, and innovation (STI) policies from a context-development perspective, focusing on the design phase of the current Dominican STI policy framework. This article focuses on the influence of economic rationales to understand the formal construction of the contemporary Dominican STI policy platform, taking into account the different economic policy cycles as context factors in the creation of an STI policy discourse as an element of development policies, in one of the most dynamic developing economies of Latin America and the Caribbean. For this purpose, four STI policy frameworks are reviewed: the National Competitiveness Plan (PNC), presented in 2007; the Strategic Plan of Science, Technology, and Innovation 2008–18 (PESCYT), introduced in the Fall of 2008; the Ten-year Plan of Higher Education 2008–18 (PDES) presented in 2008, and the National Development Strategy 2030 (NDS), introduced in 2012.

Regarding these frameworks, the following questions are raised: What are the main rationales of the Dominican's STI policies? To what extent have the STI policies influenced this time period? Given that in this article, four specific STI policy frameworks are

considered, it is necessary to highlight that STI policies, in general, do not operate independently, and in its formulation, execution, and performance interact with and are affected by other policies framework (Borrás and Edquist 2013). These policy interactions not always can be appropriately characterized but operate in an explicit-implicit continuum of intensity interactions at different levels, as can be the case with fiscal, territorial, commercial, vocational education, promotion policies for small and medium-sized enterprises (SMEs), and others (Dutrénit and Crespi 2014; Lanahan and Feldman 2015). Limiting the current analysis to the four indicated STI policy frameworks is, therefore, a decision taken to simplify the analysis and narrow it down in terms of its methodological scope. While recognizing the need for more complex analyses that deepen the structural, functional, and systemic interdependence of STI policies as part of the inherent complexity of innovation systems, it is imperative in the context of Latin American and Caribbean (LAC) countries.

Although this review is far from being a formal and systematic impact assessment of the Dominican's STI policies or an analysis of the results of the STI policy implementation process in the DR, elements may emerge that will eventually support such an assessment, which can be applied to other LAC countries. It could be especially

pertinent for small, open economies in Central America, where little is known about STI policy evaluation processes from a systematic and formal perspective (Casalet and Buenrostro 2014; Padilla-Pérez and Gaudin 2014).

From a context-development perspective, this article covers three cycles of STI policies in the DR. The first one is the industrialization and import substitution cycle, which corresponds to the development policies from the late 1960s to the late 1980s. The second one is the structural adjustment cycle, which is related to the regional influence of the Washington Consensus in the 1990s. Finally, the third one is the post-structural adjustment cycle from the first decade of the twenty-first century. The main interest of this article is the third cycle, since it was the time period in which the current DR's STI policy frameworks emerged and gained political space.

To date, there has been no consensus on a definition of STI policies, given the range of applications, territorial scales, sectoral scopes, and different levels (national or sub-national) on which such policies can operate (Laranja et al. 2008; Lanahan and Feldman 2015). In this regard, and for the purpose of this article, STI policies can be broadly defined as an articulated set of objectives, and instruments that are intended to shape, enable, support, and facilitate the creation, storage, and knowledge transfer of technological equipment and innovation products and services within economic and social systems (Nelson and Nelson 2002; Aghion et al. 2009; Edquist 2011b).

In essence and from an equally broad perspective, it would seem that this definition is no different from any other definition found in a policy analysis manual, based on shared elements such as the objectives, instruments, governance system, and interactions (polity, politics, and policy), which support the implementation and evaluation process (Varone et al. 2005; Kassim and Le Galès 2010).¹ Notwithstanding the specificity and complexity of STI policies, it rests on the intangibility of its main component, that is, knowledge, in addition to its ubiquity within social and economic systems (Hands 2002; Martin et al. 2012). Thus, certain types of policies, such as industrialization, productive development, education, or health, can be considered as STI policies (Fagerberg and Verspagen 2009). Moreover, from the perspective of the scope as well as the conceptual and methodological approach, STI policies are based on a set of rationales (under varying economic or social conditions) that delimit these policies, both in terms of the choice of instruments used for implementation and evaluation, and how the results are affected by a national institutional setting (Laranja et al. 2008; Vasudeva 2009; Borrás and Edquist 2013).

2. Understanding the regional STI policy context

In order to better understand the Dominican's STI policies, it is necessary to shed light on the regional context in which such policies have evolved over the last few decades. The current STI policy frameworks of the Central American countries were born during the structural reforms of the early 1990s, the exception being the DR (a relative latecomer in STI policies). In order to simplify the analysis at a regional level, let us focus on two critical periods: before and after the period of structural-adjustment reforms. More specifically, the period before such reforms corresponds to the long cycle of industrialization and import-substitution model implemented in LAC countries from the late 1950s to the late 1980s, while the second period corresponds to the cycle of structural-adjustment

implemented along with the 1990s (Alcorta and Peres 1998a; Vonortas 2002).

The political approach in the first cycle implied a vision of knowledge as a 'public good' provided by the state. Consequently, the policy emphasis was oriented toward scientific research, with participation mainly from public universities and associated research centers (Alcorta and Peres 1998b; Unger 2005). During this period, the prevailing approach to STI policies was the 'science push' (Hands 2002), which resulted in the creation of various pioneering organizations in Latin America such as the National Institute for Scientific Research of Mexico in 1958, the current National Council for Science and Technology (CONACYT); the Brazilian National Research Council in 1951; and the CONACYT of Argentina in 1958. In addition, it initiated the scientific and technological infrastructure in the largest Latin American economies (Alcorta and Peres 1998a; Padilla-Pérez and Gaudin 2014; ECLAC 2016).

During the cycle of structural-adjustment reforms, an aggressive process of economic liberalization, deregulation, and privatization occurred, which led to the emergence of two production patterns: labor-intensive activities such as tourist services and various free zone parks mainly consisting of textile industries in the Central American and Caribbean region; and activities based on natural resources, such as mining and metallurgy, along with the relatively stable industrial sector in the Southern Cone (Cimoli et al. 2005). Partially as a result of these changes in terms of emerged specialization patterns, STI policies were affected in different ways. In some LAC countries, private sector participation was more active, with better results regarding human resources training, joint research networks, and scientific infrastructure. These were the cases in Argentina, Brazil, Chile, and Mexico, and to a lesser extent, Colombia, Costa Rica, and Uruguay. Meanwhile, in Central America and the Caribbean, a more conservative and traditionally bounded approach to STI policies was consolidated. More precisely, this regional configuration included the public sector and universities as the leading performers of R&D. For instance, of the US\$ 64 billion spent in R&D in 2016, 28 per cent was performed by public organizations, 39 per cent was performed by universities, and 31 per cent was performed by firms, with the remaining 2 per cent performed by 95 NGOs (RICYT 2018). It is in this regional context that the DR's STI policies should be understood.

3. The DR: the policy context

3.1 An overview of the Dominican economic performance

The DR shares the island of Hispaniola with the Republic of Haiti. The DR has a surface of around 48,640 km² (or roughly two-thirds of the island), with a population of ~10 million (ONE 2012, 2017). This middle-income country includes one of the largest economies in Central America and the Caribbean, with a GDP of more than US\$ 81.2 billion in 2018 (TWB 2019a). According to this same source, the DR is also one of the fastest-growing economies in Latin America, with an average annual growth of 6.6 per cent between 2014 and 2018 (TWB 2019c). Table 1 presents the selected indicators for the DR and the countries of Central America from 2007 to 2018.

Although Table 1 does not acknowledge the dynamics of social and economic change, it at least offers a snapshot of the countries' situations. For example, in the case of Costa Rica, it doubled the size of its GDP, which was similar to the DR. In terms of human

development, the DR went from being a ‘medium human development country’ to a high one, based on the Human Development Report by the United Nations Development Program (UNDP 2018), an achievement confirmed by the decrease in poverty, falling from 41 per cent of the population in 2013 to 30 per cent in 2019 (MEPyD 2014; TWB 2019a). In Table 1, it is also interesting the convergence in the purchasing power parity (PPP) with Costa Rica a Panama, a change consistent with the reduction in poverty already mentioned.

In terms of scholarly output (e.g. the peer-reviewed journal articles), there is no doubt about Costa Rica’s leadership in this category. As for the DR, several factors may explain its poor scholarly output, but clearly, access to financing for the development of research projects is not one of them, due to the National Fund for Innovation and Scientific and Technological Development (FONDOCYT). Among the factors that can explain such low productivity are the reduced number of doctoral-level scholars in the higher education system (which refers to the problem of resources and human capital devoted to professional research) and the fundamental teaching approach used in the Dominican university system as well as in the small number of organizations dedicated to research and knowledge production (OECD 2012a: 145–147; Riggio 2017).²

In terms of the country’s economic performance, there is no doubt about its success in regional growth from 2007 to 2018, as shown in the average annual growth of 5.3 per cent, compared to 2.3 per cent for the Latin American and the Caribbean region (TWB 2019b). In other words, the DR economy grew at a rate that was

almost double that of the region. Based on the data from the Central Bank of the DR (BCRD 2019a,b), Fig. 1 shows the economic performance of the country from 2007 to 2018.

Despite the sustained increase in the GDP, the behavior of annual rates indicates that they are more sensitive to internal and external shocks, such as the effects of climate variability in 2017, which contracted the expected growth between 4/10 and 5/10 (CNCCMDL 2016; BCRD 2019a,b). In sum, from 2007 to 2018, the DR not only changed its point of view from macroeconomic performance, but also from the perspective of human development and poverty reduction, thus achieving a significant increase in public education spending (4 per cent of the GDP), an increase in the added value of export goods and services, and higher social security coverage. These advancements cannot be attributed to the direct effect of the STI policy frameworks, but rather to the complicated dynamic regarding the feedback of different signs.

3.2 The DR’s STI policies from a context-development perspective

The DR’s twenty-first century STI policies were initiated with the enactment of Law 139-01 on higher education, science, and technology in 2001, following its regional peers. However, from a historical perspective, the STI policies emerged as part of the aforementioned industrialization and import substitution cycle at the end of the 1960s (Alcorta and Peres 1998b). Table 2 summarizes the STI policy frameworks and their long-term development in the DR.

Table 1. Selected indicators for the DR and the countries of Central America

Country	Population (in millions)		Current GDP (in US\$ billions)		GDP per capita in PPP (in US\$ thousands)		HDI (UNDP) ^a		Journal articles ^b	
	2007	2018	2007	2018	2007	2018	2007	2018	2007	2018
Costa Rica	4.4	4.9	26.7	60.1	11,625	17,645	0.73	0.79	520	1,171
DR	9.3	10.6	44.1	81.2	9,853	17,799	0.68	0.73	61	186
El Salvador	6.1	6.4	17.0	26.1	5,847	8,317	0.65	0.67	41	136
Guatemala	13.7	17.2	34.1	78.4	6,327	8,447	0.57	0.65	100	305
Honduras	7.8	9.5	12.2	23.8	3,723	5,130	0.58	0.61	38	185
Nicaragua	5.5	6.4	7.4	13.	3,732	5,524	0.60	0.65	70	145
Panama	3.4	4.1	21.2	65.1	12,202	25,509	0.74	0.78	301	659

Sources: World Bank (2019b), ^aUNDP (2019), and ^bSCIMAGO (2019).

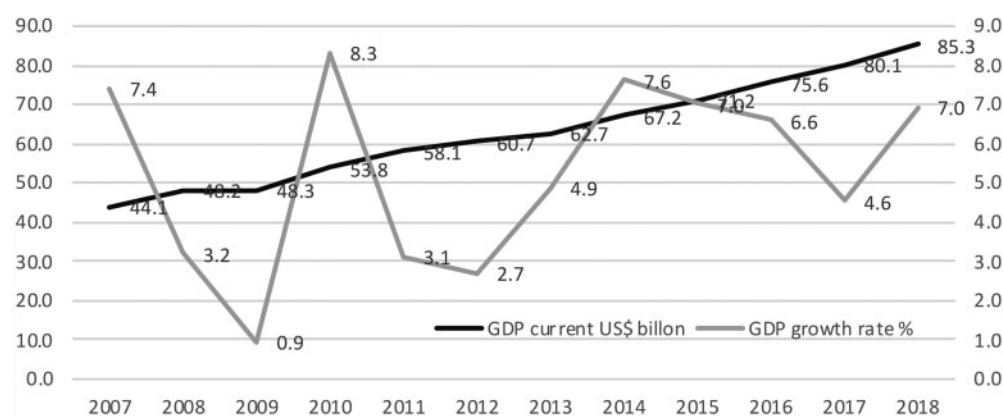


Figure 1. The Dominican Republic’s Economic Performance (2007–18). Source: Central Bank of the DR (2019).

Table 2. The DR's STI policy frameworks

No.	Policy instruments	Public bodies	Year
1	Law 299-68 on incentives and industrial protection	The Industrial Development Corporation (formerly CFI and currently PROINDUSTRIA)	1968
2	Law 116-80 on creating a national system of technical-vocational training	The National Institute of Vocational and Technical Training (INFOTEP)	1980
3	Law 8-90 on fostering export free zones, firms, and parks	The National Export Free Zones Council	1990
4	Law 19-00 on intellectual property with an emphasis on copyrights	The National Office of Intellectual Property (Britt) Copyrights	2000
5	Law 20-00 on intellectual property with an emphasis on industrial property	The ONAPI	2000
6	Law 139-01 on higher education, science, and technology	The Ministry of Higher Education, Science, and Technology (MESCYT)	2001
7	Law 392-07 on competitiveness and innovation	The PROINDUSTRIA (Ministry of Industry, Commerce, and MSMEs)	2007
8	Decree 190-07 on the national innovation and technological development system	The collegiate body chaired by the MESCYT.	2007
9	National Competitiveness Plan	The National Council of Competitiveness (CNC)	2007
10	The Strategic PESCYT	The Secretary of Higher Education, Science, and Technology	2008
11	The Ten-year Plan of Higher Education 2008–18	The Secretary of Higher Education, Science, and Technology	2008
12	Law 1-12 on the national strategy for development 2010–30	The Ministry of Economy, Planning, and Development (MEPYD)	2012
13	Law 166-12 on the national quality system	The Dominican Institute for Quality (INDOCAL)	2012
14	Law 253-12 on the national agricultural and forestry research system	The Council for Agricultural and Forestry Research or CONIAF.Ministry of Agriculture-National	2012
15	Law 542-14 that modifies several articles of Law 392-07 on competitiveness and innovation	PROINDUSTRIA	2014
16	Decree 237-15 on the National Productivity and Competitiveness Initiative	The collegiate body by the government and private sectors	2015

3.2.1 Industrialization and import substitution cycle

It is beyond the scope of this review to specifically analyze each law and policy instrument in Table 3. However, among the laws and policies corresponding to the industrialization and import substitution cycle, three deserve more attention, since they have a greater long-term impact: Law 299-68, Law 116-80, and Law 8-90. The first one constitutes the archetype of this period of industrialization and import substitution, since it focuses on providing incentives, fiscal exceptions, and low-rate loans to foster industrialization,³ while the second one focuses on creating a national system of technical-vocational training to support industrialization, based on similar models in Argentina, Brazil, and Mexico as well as Central America and the Caribbean (Sevilla and Dutra 2016). As for the third one, it has had a multi-dimensional impact over time, which, regardless of the technical and political criticisms and necessary revisions (Pozo et al. 2010; Daude et al. 2017), has contributed to the competitive profile of the Dominican economy, especially the industrial sector.

Until the mid-1980s, the Ministry of Agriculture of the DR played a crucial role in promoting research initiatives and technology transfer in the field of agriculture although it was not part of a comprehensive STI policy framework. Its primary focus was to ensure national food security, especially in the context of the 'Green Revolution', which stimulated the development and adoption of high-yield crops in developing countries (Evenson and Gollin 2003).

In general, from today's perspective, it could be stated that the primary policy rationale in this time period was Schumpeterian endogenous growth, but in the case of the DR, it was a formally structured STI policy approach.

3.2.2 The cycle of structural adjustments and policy reforms

At the end of the 1990s (and with the change of government in 1996), accelerated modernization of the state began, supported by the former Commission for State Reform and Modernization (CONARE). The deployment of CONARE's agenda helped close the gap between the economic liberalization and trade opening agenda spawned by the so-called Washington Consensus of the early 1990s and the influence of international organizations such as the World Bank and the International Monetary Fund (Gore 2000; Rodrik 2006; CONARE 2008).⁴ However, despite the initial 'progress' of the DR in the liberalization and modernization agenda, by the second half of the 1990s, the country had become stagnant, due to the relative political isolation by the 1994 political crisis (Daude et al. 2017). This resulted in an institutional crisis that led the country toward a new political and institutional order, represented by the shift from a conservative government to a more liberal one. This ultimately boosted the neoliberal agenda through the privatization of public firms, commercial openings, reforms, and the modernization of the state (Stoyan et al. 2014).

A fundamental milestone of the reform process promoted by CONARE was the 'National Dialogue', which, among many other objectives, not only sought to articulate an agenda of economic liberalization that could meet the challenges of growth and economic openness, but also aimed to resolve the country's social challenges (Espinal 2001). It was in this context that Law 139-01 emerged. This law conciliated the system of higher education represented by the former National Council of Higher Education and the idea of a formal system of science and technology, by building a combined

Table 3. STI policy rationales, principles, key tenets, policy focus, and approaches

STI policy rationales	Principles	Policy instruments	Key tenets	Policy scales	Policy approach
Neoclassical	The macroeconomic intervention of the state STI policy to correct market failures The high aggregate level of the economy; economic growth	Tax benefits for R&D activities; tax credits; and sectoral loans Public subsidies and direct transfer mechanisms Centralized technology infrastructure services	Free markets; international commerce; Subsidies Openness Market liberalization	National	Top-down
Schumpeterian growth	Endogenous growth Regions as beneficiaries of STI policies Policy failures related to knowledge and technology diffusion	Human capital formation (scholarship programs) Subsidies for research and R&D activities; industrial policies; regional development policies Technology parks and voluntary certification programs; foreign investment incentives	Growth Regulations Incentives Technology R&D Normalization Certifications	National; regional	Top-down
Neo-Marshallian	Geographic emphasis: spatial scales Regions as active actors in STI policies The crucial role of industrial districts and clusters SMEs with a crucial role in economic performance and absorptive capacity	Regional training programs and shared technological services and infrastructures; regional policies; incubation activities Fiscal benefits for technology acquisitions (fiscal exemptions, tax credits); clusters policies; competence laws Guaranteed funds and special credit programs for SMEs	Productivity Competitiveness Innovation Clusters policy Industrial districts Economy sectors SMEs Technological services Credit policies Productive chains University business Research dynamics Training and learning dynamics Institutions Coordination Networks	Sub-national; regional; sectoral	Bottom-up
Systemic-institutional	Positive externalities of knowledge production and diffusion at different scales Institutional strengthening as a goal and network-interaction mechanisms at a different level Systemic performance by collective learning and building capacity dynamics	Subsidies for collaborative R&D and innovative activities between firms and universities Collaborating networks and shared technological services portfolios; innovation vouchers and IP policies Subsidies and fiscal benefits for professional training programs and shared training services		National; sectoral	Top-down and bottom-up
Evolutionary structuralist	Institutional dynamics related to knowledge production and diffusion into the economic system. Innovation system approach and competence building system Multilevel setting approach to support dynamic economic change	Competitive research grants for universities and research centers Professional accreditations services programs and extension services; innovation vouchers Incubation activities; venture capital programs; public procurement programs	Levels and governance scales Regions Local dimensions Inclusion Actors or stakeholders	National; sub-national Regional; sectoral	Bottom-up

national system of higher education, science, and technology (OECD 2012c).

In parallel to this process, the intellectual property laws were enabled within the processes of trade openings and globalization, based on the creation of the World Trade Organization (WTO) in 1995 and the global agreement on 'Trade-related Aspects of Intellectual Property Rights' (Park 2002).⁵ These new frameworks consisted of Laws 19-00 and 20-00, which covered intellectual property with emphasis on copyrights, and industrial property, respectively. Consequently, two separate public entities were created: The National Office of Industrial Property (ONAPI) and the National Office of Copyrights. This new legislation also enabled the national capacity to respond to the international requirements in economic and international trade established by the WTO. However, due to certain structural conditions in the DR, advances in industrialization and the technology transfer approach in this period were gradually left behind in favor of a more neo-classical approach that supported commercial openness, market liberalization, and the wave of privatization in the second half of the 1990s, with the gradual loss of the manufacturing sector in GDP in favor of the services sector.

3.2.3 The post-structural STI policy cycle

Law 139-01 and the 2007–8 time period are particularly important for this review.⁶ As the policy framework emerged or was reformed during the period of structural adjustments and pacification in other LAC countries (especially the Mesoamerican ones) (Padilla-Pérez and Gaudin 2014), in the Dominican case, the process was delayed for more than a decade, thus making the country a regional late-comer in regard to formally structured STI policies. This is the basis for the post-structural STI policy cycle.

3.2.3.1 The PNC (the National Competitiveness Plan). The PNC, introduced by the National Competitiveness Council (CNC) in March 2007 (CNC 2010), was intended to build the general conditions for promoting long-term competitiveness and growth based on the 'systemic competitiveness model' (CNC 2007: 3). This model consisted of six axes of public policies: (1) a microeconomic or business model to create business and labor capital; (2) a sectoral economic model to support industrial clustering in key sectors and activities; (3) a macroeconomic model to promote competitive and stable growth; (4) an international model to foster openness; (5) an institutional model to support legal certainty; and (6) a political and social model to promote social capital formation. Regarding innovation, the PNC emphasized the following three pillars: (1) the creation of a network of institutes to promote innovation and technological development (i.e. sectorial R&D facilities); (2) a network of incubators to foster entrepreneurship; and (3) the creation of technoparks as innovation spaces (CNC 2007: 120).

Overall, the PNC is a complex policy framework with ramifications in its related policy instruments, especially the national system of innovation and technological development created by Decree 190-07 and Law 392-07 on competitiveness and innovation. However, the PNC's systemic effects on productivity and competitiveness through instruments, such as Law 392-07 and its reform through Law 542-14, have yet to be adequately evaluated. Thus, it is important to determine the impact of the PNC and its related instruments in order to incorporate their advantages in future assessment initiatives.

3.2.3.2 PESCOT 2008–2018. PESCOT is one of the critical milestones in the history of the DR's STI policies and it deserves more attention in terms of its scope as STI policy framework. Created over a period of eleven months (from the last quarter of 2007 to October 2008), the purpose of the plan was to foster dialogs between governmental actors, business representatives, actors in civil society, and representatives of the Academy of Sciences of the DR (OECD 2012b; UNCTAD 2012). It was the first set of policies built to explicitly address national challenges from an STI perspective (Navarro 2009; UNCTAD 2012). The plan also received the support of the National Council for Innovation and Technological Development.⁷ Overall, the PESCOT consisted of four components: (1) the institutional and financial strengthening of the national system of science, technology, and innovation; (2) the development of scientific research, innovation, and technology transfer program; (3) the formation of human resources for science and technology; and (4) the creation of a program for the dissemination and social appropriation of science and technology (SEESCOT 2008a,b).

However, several questions are raised in regard to this plan: What happened to this plan? To what extent were its goals achieved? What about the critics of its ambitious financial goals? What story can the evidence tell? To date, the results of any formal impact assessment are unknown. According to the World Bank (TWB 2019b) and the data reviewed by the Dominican Central Bank (BCRD 2019a,b), from 2007 to 2018, the country's economic growth expectations achieved an average growth rate of >5 per cent, with an increase in the GDP from US\$ 44.1 billion in 2007 to US\$ 85.3 billion in 2018 (an increase of 93.3 per cent).

In principle, it can be argued that if the plan's funding goals have not reached the expected magnitude, then it was not due to the country's performance, especially in the context in which investments in education have increased by 4% of the GDP since 2013. However, maybe there is more beneath the surface. According to the MESCOT data of the 2009–18 time period, 337 research projects were approved, representing 92.8 per cent of the total number of studies receiving research grants or ~US\$ 52.7 million (MESCOT 2019). This amount represents ~60.7 per cent of the expected US\$ 87 million to be spent in the 'scientific research, innovation, and technology transfer program' of this plan (SEESCOT 2008b: 125). However, a more thorough evaluation of this plan should be conducted regarding its financial goals, especially in the context of the DR's STI policies. In the absence of a formal impact assessment, its most significant legacy is likely to be more cultural; that is, it lays the foundations for specific STI policies in connection with the development and inclusion of societal challenges in the country.

3.2.3.3 The PDES 2008–2018. The formulation of the PDES ran parallel to the construction of the PESCOT by the then Secretary of State for Higher Education, Science, and Technology, and the current ministry of the same branch (SEESCOT 2008a). It should be noted that, although the PDES began several months before the PESCOT, it concluded several weeks later. Moreover, in terms of its scope, it did not have the same level of dissemination and influence as the PESCOT, although it constituted an STI policy framework. In essence, the PDES was based on two significant challenges of the Dominican higher education system: (1) coverage and social inclusion and (2) the quality of teaching staff and the training offered at the undergraduate and graduate levels. Although this plan proposed an approach on STI topics from the perspective of higher education, in practice, it was primarily based on the PESCOT.

Similar to the PESCYT, in the absence of a formal impact assessment, it can be stated that, as of 2018, the DR has closed the gap concerning its regional peers by referring to the gross and net enrollment rates in higher education (López and Mejía 2016; Ferreyra et al. 2017). Regarding the quality of the system and its relevance, due to the heterogeneity and diversity of the higher education system in the country, it is difficult to make a global evaluation, except for recognizing certain efforts and mechanisms to meet the structural challenges of the country's higher education system (López and Mejía 2016: 40).

3.2.3.4 The NDS 2030. The purpose of the NDS, as a long-term policy framework, was to transform the DR into a developed country by 2030. Formulated from 2006 to 2010, and concluding with the promulgation of Law 12-01 on the DR's National Development Strategy (MEPyD 2016), it consisted of four axes: (1) the strengthening of public institutions and the administrative transparency of the state; (2) social cohesion and equity; (3) a more articulate and innovative economy; and (4) sustainable management of the environment. The third axis, in particular, includes a long-term perspective, based on the objectives and indicators of the PESCYT (e.g. the promotion of research and development programs, scientific dissemination and dissemination, technological transfer to productive sectors, capacity-building for innovation, etc.) (MEPyD 2016: 60–62). The fact that the NDS considers the strengthening of the national system of science, technology, and innovation creates an opportunity to build on the cultural legacy of the PESCYT. In addition, it supports a more integrative and convergent STI policy approach in terms of its contribution to the country's development goals. It is important to note, however, that this is a short-term task that must be undertaken in the form of a national innovation strategy or a second national science and technology plan.

3.2.4 STI policy efforts after the NDS

Regarding STI policy efforts after the NDS, one of them was the Decree 237-015 on the National Productivity and Competitiveness Initiative. Established in August 2015, the purpose of this decree was to create a public–private partnership (with significant participation from the private sector) in order to achieve the goals of the NDS's third axis. To date, the results of Decree 237-15 cannot be explicitly identified, especially in regard to the potential of incorporating the business sector into the national innovation system. On 29 December 2018, Presidential Decree 453-18 was issued, which declared 2019 as the year of innovation and competitiveness. Most likely, and without any relation to the PESCYT, this decree closed a decade-long cycle of STI policy discussions in the DR, while paving the way for new STI policymaking processes whose construction and outcomes have yet to be seen.

4. STI policy rationales

At this point, it should be noted that STI policies are not usually homogeneous blocks, but they combine elements of different rationales, including policy justifications, goals, expected results, implementation instruments, scales and levels of application, types of beneficiaries, and monitoring and evaluation mechanisms, which make up a complex policy system (Magro and Wilson 2013). The combination of these elements used to achieve STI policy objectives and influence different levels and dynamic interactions of an innovation system make up a 'policy mix' (Magro and Wilson 2013;

Lanahan and Feldman 2015).⁸ It is under this perspective that the different STI policy rationales can be understood, including the interactions and influences in the definition of policy goals, the subsequent selection of implementation instruments, and the way that the policy effects are perceived, measured, and valued (Smits and Khulmann 2004; Borrás and Edquist 2013).

Following Laranja et al. (2008), the primary sources of STI policy rationales are based on the most relevant trends in economic thought over the past five decades such as neoclassical, Schumpeterian growth theory, neo-Marshallian, a systemic–institutional approach, and evolutionary thought (Falk et al. 2007; Martin 2012; Bach et al. 2014). These could be incorporated with other influences, such as the triple–helix model and its adaptations (Etzkowitz and Leydesdorff 2000; Ranga and Etzkowitz 2013), which has had a significant influence in Latin America and the Caribbean. Hence, it could deserve an independent and more detailed analysis. It is important to note that this evaluation process, from the perspective of university–business–government cooperation, began because of its specific influence in LAC countries (Crespi and Zuñiga 2012; BID 2014; Dutrénit and Crespi 2014; Navarro et al. 2016). An initial review regarding the influence of the triple helix model in the DR, from the perspective of international innovation cooperation from 2001 to 2007, can be found in Villarreal and Calvo (2016). However, in order to delimit the analysis, let us follow the same five economic sources of STI rationales.

In essence, the neoclassical approach is based on the premise that the intervention of the state is justified in order to overcome market failures, such as 'sub-optimal' levels of knowledge production, which may affect competition and the operation of market forces. Thus, the state should provide resources and support to foster scientific and technological research (Magro and Wilson 2013: 1648). Besides, when optimal levels of knowledge production are reached, then the natural mechanisms of the market will suppress or neutralize any imbalances that may affect market functioning, thus linking this approach with the linear perspective on innovation (Švarc and Dabić 2017). Some of the mixes of instruments under this approach usually include subsidy policies and fiscal incentives for R&D, investments in scientific and technological infrastructure, and the development of projects, such as science and technology parks, to stimulate collaboration between the various actors of the system, among others (Borrás and Edquist 2013; Ghazinoory et al. 2017).

The Schumpeterian approach to endogenous growth highlights learning processes and R&D spending as factors that stimulate innovation results. This offers a more microeconomic focus that is closer to the structure–behavior–result paradigm, by making knowledge, human capital, and technology endogenous factors that allow for increasing returns of capital and labor (Romer 1994; Bach et al. 2014). This approach favors the regional concentration of knowledge resources, the generation of knowledge spillovers, and its transformation in the economic value of a more aggregate level. Moreover, it emphasizes regional development policies and it is intended to correct policy failures that affect efficiency in knowledge production and diffusion (Uyarra 2008; Casper 2013). Investments in human capital, subsidies for research and innovation projects, tax benefits for R&D, and investments in technological infrastructure and technology parks are part of the broad mix of instruments under this rationale (Magro and Wilson 2013).

The neo-Marshallian approach emphasizes the social, cultural, and institutional conditions of growth within regions. Unlike the Schumpeterian approach, regions are agents of STI policies (Laranja et al. 2008; Vicente García Manjón and Romero Merino 2012).

Under this logic, geographical proximity is fundamental for cost reduction since it facilitates information exchange, knowledge diffusion, and technology transfer (Fiore et al. 2011; Lau and Lo 2015). The instruments under this rationale include: shared technological infrastructures, local or regional development agencies, and the promotion of associations to share specialized services, including training and technology transfer, incubation programs, intellectual property support, and other related services (Devarakonda et al. 2018). A reference to the neo-Marshallian rationale is the Italian clustering experience of small manufacturing firms and its high value-added chains in terms of technology services (Nachum and Keeble 2003; Fiore et al. 2011). This approach also highlights the role of SMEs and investments in less-favored regions in order to improve their economic performance and absorptive capacity (Acs and Varga 2002; Lau and Lo 2015). One of the main influences of the neo-Marshallian approach can be found in Porter's (2000) reinterpretation of the roles of location, agglomerations, and cluster dynamics in regard to the competitiveness of firms at an aggregate level (Porter 2000; Konzelmann and Wilkinson 2017).

The systemic-institutional approach suggests that the benefits of positive externalities, derived from the knowledge production and diffusion process, can be (more or less) efficient, depending on the strength of the institutional context and the networks that support the learning interactions and knowledge dynamics among the system's stakeholders (Aghion et al. 2009; Ghazinoory et al. 2017). Under this rationale, institutions, the interaction networks, and the links between stakeholders become relevant. One of the pillars of this rationale is the notion of systemic failures, which arises when stakeholders' connections and links do not support the shared knowledge production processes (Edquist 2011b). This rationale also refers to several aspects regarding the efficiency of network connectivity, learning failures, and technological development paths (Chaminade et al. 2009; Ahlqvist et al. 2012). Moreover, this systemic approach operates on both a national and regional scale. For instance, some of the policy instruments under this rationale can be the creation of regional networks, inter-institutional governance bodies, extension services, subsidies for collaborative projects between firms and universities, and other related instruments (Smits and Khulmann 2004; George and Prabhu 2005; Ahlqvist et al. 2012).

The evolutionary-structuralist approach considers technology as a combination of tacit and explicit knowledge based on the dynamics of value creation in an economic system (Laranja et al. 2008: 829). Essential tenets of evolutionary thinking are the dynamics of economic change and the relationship between technology and mechanisms in which knowledge diffusion occurs (Metcalf 1994; Ghazinoory et al. 2017). Thus, it focuses on learning and the cognitive dynamics of different systems' stakeholders at the public and private level, by considering regions and multiple scales as interaction policy spaces (Intrakummerdi and Cristina 2007; Flanagan et al. 2011). One distinction of this rationale is the perspective regarding formal and informal institutions. In this regard, they are considered as units that include internal dynamics and specific evolution trajectories, which theoretically supports the innovation system approach (Nelson and Nelson 2002; Vasudeva 2009; Edquist 2011a). Policy instruments, such as voluntary standardization, certifications, public procurement programs, public-private partnerships, codes of conduct, and so on, can also be found (Borrás and Edquist 2013; Bach et al. 2014).

Finally, the various STI rationales can operate at different levels and scales of the economic system, which includes the types and

priorities of knowledge systems to be stimulated, and the selection of technologies associated to a specific path of knowledge production. These dynamics may also affect the STI policymaking process at a different level, including the firms' responses to specific policy instruments (Etzkowitz and Leydesdorff 2000; Havas et al. 2010; Magro and Wilson 2013; Bach et al. 2014). At the same time, STI rationales may influence territorial levels, depending on the instrument's policy configurations and the interactions of the STI policy agents in different governance spaces (Lanahan and Feldman 2015). In other words, STI rationales may influence (in a dynamic and intertemporal manner) the types of interactions between various policy agents, the roles that they play, the types of selected beneficiaries, and the levels and scales of their interactions. Thus, they transform the STI policy mixes into a complex system that feeds back through direct and indirect channels, which, in turn, generates autonomous outcomes not foreseen in the initial STI policy configuration.

5. Methodological approach

From the methodological perspective, the identification of the rationales of the four frameworks of the STI policies of the DR started from a qualitative approach based on ground theory (Timmermans and Tavory 2012). In general terms, grounded theory consists of an inductive method that seeks to construct a theory based on the systematic review and data collection (Timmermans and Tavory 2012). Once the data are collected, its systematic review tends to support discovering theories based on the data. It builds a general description, which at the same time fits with the theory and the data from which emerge. The grounded theory approach tends to start with a couple of research questions about the phenomena under study, subject to an intense interaction between the data-gathering process and the analysis, making this approach suitable for context-based studies, case reviews, and policy dynamics description. This approach consisted of three steps and the first step was the review of the five economic rationales outlined in Section 4. The second step after reviewing rationales, it was to build a consolidated table (Table 3) in which five key elements were defined to deconstruct these rationales. These five elements are the principles, the instruments, the key tenets, the political scale, and the political approach. The principles, in this case, refer to the more general conceptual guidelines that define each policy rational according to the literature reviewed in Section 4. The policy instruments refer to economic tools set to achieve policy goals, including tax rates, subsidies, guarantee funds, among others (Smits and Khulmann 2004; Borrás and Edquist 2013). The key tenets refer, in this case, to those traits of the economic theories related to the identified STI rationales in Section 4 (Falk et al. 2007; Laranja et al. 2008). The policy scales refer to the spatial level of governance in which the STI policies can operate as well as the interactions among various actors (Magro et al. 2014; Lanahan and Feldman 2015). As for the policy approach, it refers to the coordination and implementation mechanism, which can be either top-down or bottom-up, including the different types of centralized and vertical coordination. The roles of public agencies range from different concentration levels to a more deconcentrating focus, and horizontal approaches based on varying degrees of agents' participation and the beneficiaries in STI policy implementation and evaluation (Magro et al. 2014: 373). A detailed discussion of the different roles that stakeholders play in STI policies can be found in Flanagan et al. (2011). Table 3 presents a summary

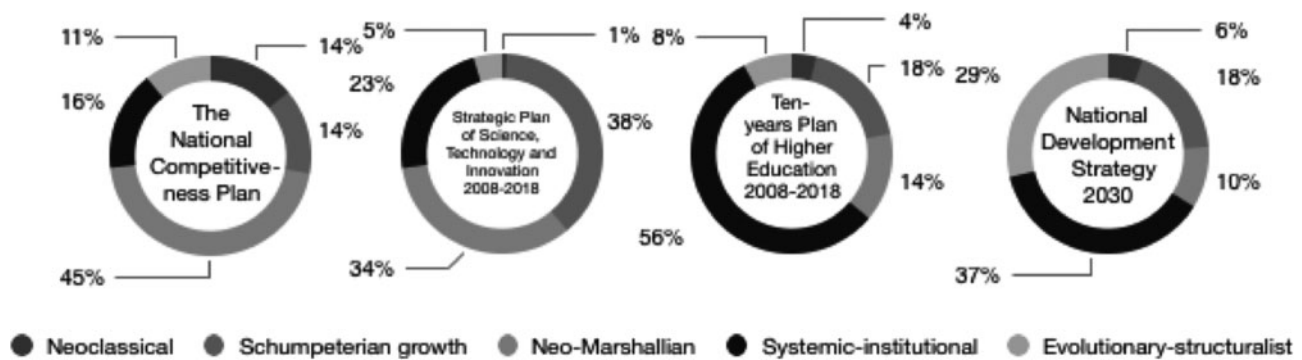


Figure 2. The key rationales in the DR's STI policy frameworks.

of the different STI policy rationales outlined in Section 4 and its elements.

As can be seen in Table 3, the variety of STI policy instruments can be used in different policy rationales, and simultaneously the same policy instrument can serve to achieve differentiated STI policy objectives (Borrás and Edquist 2013; Bach et al. 2014). In the case of the selected forty key tenets, due to their connections, combination, and interactions, it is expected that some of them would be repeated in those conceptually closest rationales. From the methodological point of view, this possibility was accepted as a minor problem.

The third methodological step was to use the forty key tenets to build a dictionary associated with the five discussed STI rationales. The built dictionary was used in each of the Dominican STI policy frameworks to analyze the influence of the different policy rationales in each of them. The software used was MAXQDA version 11, which generated an output (Supplementary Annex S1) with the results.

6. Rationales in the Dominican STI policy frameworks

This section highlights the rationales founded in DR's STI policy frameworks. It is essential to emphasize that these policy frameworks are complex policy instruments based on the policy mix approach (Flanagan et al. 2011; Magro and Wilson 2013). This approach implies a combination of policy options intended for intertemporal and multilevel impacts in the country's economic performance. Regarding the results, Fig. 2 shows the rationales composition founded in each of the analyzed Dominican STI policy frameworks.

The percentages in Fig. 2 are entirely debatable, since a different number of key tenets and related configurations can be used. Supplementary Annex S1 shows the consolidated results of the MAXQDA software's output. The PNC and the PESCYT look more similar to each other, sharing three rationales: the neo-Marshallian, the institutional-systemic, and the Schumpeterian growth approaches. The PDES and the NDS, share the systemic-institutional, the Schumpeterian growth approach, and to a lesser extent, neo-Marshallian rationale.

In the PNC, neo-Marshallian rationale clearly predominates. Cluster policies, regional and sectoral approaches to innovation, references to industrial districts, technical support for MSMEs, incubation activities, and tax incentives and fiscal benefits in terms of infrastructure and technological acquisition are defined in this plan and reflected in Laws 392-07 and 542-14. This also indicates that,

although it may have some elements of systemic-institutional rationale, there is no doubt a neo-Marshallian approach in the PNC. It is important to note that, despite its neo-Marshallian influence, a top-down policy approach still prevails.

In the PESCYT, the primary rationale is Schumpeterian growth, followed by a neo-Marshallian approach, and systemic-institutional reasoning. For instance, the economic justification is Schumpeterian (SEESCYT 2008b: 61–65). This plan also highlights the need for strengthening not only the institutional setting in which the STI system rests, but also the interinstitutional and intersectoral coordination and articulation mechanisms necessary for the plan to succeed.

The evolutionary-structuralist rationale also supports the justification of a gradual transition toward a knowledge-intensive society and economy. Moreover, the remaining components of the PESCYT overlap the rationale of Schumpeterian growth with systemic-institutional rationality. Thus, in Component 2 on the development of R&D programs linked to the productivity and competitiveness of the productive sectors (SEESCYT 2008a: 125–142), the rationality of endogenous growth is predominant, while in Component 3 on human capital for science and technology (SEESCYT 2008b: 142, 143), it is important to note the systemic-institutional rationality around the notion of human capital policy failures. In Component 4 on the public engagement of science and technology, systemic-institutional rationality can be found, although some evolutionary-structuralist elements are proposed, based on the premise of generating structural changes concerning knowledge diffusion in the social and economic system (SEESCYT 2008b: 144). Meanwhile, Schumpeterian growth is found in the centralization focus on STI policy implementation and in the commitment established by fostering the STI policy as part of the country's economic dynamics. Such dynamics are also based on the endogenization of knowledge and technology, as engines of long-term economic growth (SEESCYT 2008b: 62–68).

In the case of the PDES, and due to the heterogeneity and diversity of organizations and actors that are part of the higher education system (including the spatial concentration of higher education organizations), a clear systemic-institutional logic prevails. The challenges in terms of the coverage and quality in its different facets are assumed to be system failures, which can be partially explained by the high entropy associated with the years of regulations or deregulations. For this reason, this systemic-institutional rationale overlaps with the command-and-control approach, which is a challenging issue previously highlighted in the evaluation of higher education policies in the DR (OECD 2012a: 166).

The NDS is a document of high complexity, due to its long-term perspective and the structure of objectives and indicators that clearly

build a single evaluation mix for each of its four axes. However, in general, a systemic–institutional rationale overlaps with evolutionary–structuralist reasoning throughout the NDS, due to the political transformation and consolidation of the rule of law, institutional development, and social inclusion that prevails in the STI policy.

In the NDS, the influence of the Schumpeterian approach is apparent, due to the endogenization of knowledge and technology, as engines of productivity and competitiveness for which investments in innovation and human capital formation constitute medium- and long-term objectives (MEPyD 2016: 60). The policy and market failures that have limited the competitive potential of the Dominican economy are also expected to be corrected, thanks to capacity-building in innovation and productive transformation. Moreover, neo-Marshallian insights can be seen in the objectives and lines of action aimed at strengthening sectoral, regional, and local production capacities. Finally, the creation of technological services and infrastructures for the standardization, accreditation, and quality of micro-, small-, and medium-sized enterprises (from the perspective of improving productivity) and the cluster approach (from the point of view of linking the chains of specific sectors such as agriculture, manufacturing, and tourism) clearly show the weight of the neo-Marshallian influence on the third axis of the NDS (MEPyD 2016: 66, 67).

Concerning the first research question raised in this article, and within the limits of the grounded approach it is clear that, in the Dominican STI policy frameworks, three rationales prevail: (1) a systemic–institutional nature; (2) a neo-Marshallian approach; and (3) a close-up Schumpeterian growth perspective. This general composition somewhat recognizes the systemic and institutional failures that still affect the growth and development potential of the country. However, it seems that this negative cycle can be broken through concerted policies, transparency, and considering a medium- to long-term STI policy formulation perspective.

Concerning the extent of the STI policy influence in the Dominican's economic performance in the analyzed period, and without a proper evaluation of the impact of STI policies, it is not straightforward to determine to what extent they contribute to the dynamics of economic growth and performance. Various factors, such as favorable a national and international macroeconomic environment, an increase in foreign direct investments, economic growth driven by aggregate domestic demand, tourism growth, and the increase in exports can undoubtedly explain the prolonged growth cycle with greater robustness. However, there is no doubt that STI policies play at least a cultural role in defining a new approach to development policies in the DR. One possible hypothesis may be that STI policy frameworks have a latent effect (e.g. cultural, political, and institutional) when boosting and supporting economic growth in combination with other structural and cyclical factors. Another hypothesis could be a more direct effect, especially through instruments and initiatives derived from the PNC, for example, the neo-Marshallian influence in supporting SMEs and clusters through the creation of 'centropymes' (MICM 2018). This is an interesting attempt to create SME–university–government interfaces throughout the country. Such hypotheses, however, must be corroborated with further analysis.

In sum, the insertion of rationales into a specific policy framework does not necessarily follow an explicit intention on the part of the agents involved in STI policymaking. On certain occasions, this intention may be explicit, but it depends on the country's context and the interactions of the public policy agents. As for the dynamics of the STI policymaking, the influence of these rationales should not

only be taken into account (as ideological grounds), but also the technical elements should be considered in terms of their implications for the implementation, monitoring, and assessment processes associated with the policymaking dynamics.

7. Concluding remarks

The complex multilevel STI policy system built during the time period covered in this article cannot be adequately assessed without building an evaluation mix and conducting exercises, which are far from the purpose of this article. However, what can be achieved are more meditative, prospective, and general exercises regarding the possible contributions of the STI policies on the country's growth performance. In this regard, understanding the rationales of the Dominican STI policies shed light on how to develop this evaluation mix, how to define the next generation of STI policies, and how to align them with sustainable development goals in order to boost productivity and competitiveness.

In terms of challenges and opportunities, there are at least four elements for the next generation of STI policies in the DR could be briefly comments: (1) overcoming coordination failures and improving governance; (2) rethinking business–university relationships; (3) incorporating a STI policy demand approach; and (4) applying a regional and multilevel approach to innovation systems.

Regarding the coordination failures, it is one of the most relevant issues that need to be addressed in the next generation of STI policies in order to enable the links, connections, and functions that make the innovation system work. Some authors have described the 'negative coordination' phenomena (Magro et al. 2014: 373), in which political actors operate in evident interdependence, but are attentive to adverse responses to their initiatives by other agents. It is possible that, given the level of STI political progress, the time has come for the DR to rethink the institutional governance of STI policies in a more autonomous and decentralized manner. However, any change in the governance model must maintain the support by the university system, especially through instruments, such as the FONDOCYT, which must be strengthened and redefined in order to consolidate the capacities in the field of knowledge production and the links with the productive sectors.

Concerning the rethinking of the business–university relationship, in the regional context, universities are becoming increasingly involved in joint initiatives of production and knowledge transfer with firms and productive sectors. However, there are still considerable challenges to overcome (Barro 2015). Thus, one of the critical challenges of the next STI policy framework will be to overcome the institutional biases that have limited university–business collaborations whose maximum expression has been the FONDOCYT's bias in favor of university financing.

In regard to incorporating an STI policy demand approach into the UNCTAD's STI policy review, one of the most exciting possibilities (from the perspective of the articulation of the innovation system) is the market formation (UNCTAD 2012: 48). The importance of the demand side in STI policies cannot be underestimated, due to its role regarding the willingness and ability to absorb knowledge and new technologies as public procurements (BID 2014; Moñux and Uyarra 2016). From the previous perspective, the STI policy demand approach opens a window of opportunity that strengthens the country's innovation system in a more proactive and productive manner, by linking and strengthening the knowledge production flows among the stakeholders of the national innovation system, which, in

turn, spurs long-term productivity and growth (Braunerhjelm et al. 2010; Crespi and Zuñiga 2010; Grazzi et al. 2016).

In relation to the incorporation of a regional and multilevel approach, the value of this approach is that it recognizes the importance of diversity and highlights the growth potential of certain regions, local territories, and associated economic activity sectors, as both policy actors and beneficiaries of STI policies. This recognition goes beyond the cluster policies and regional development, by strengthening the regional innovation system and by incorporating regions as part of the governance interactions that occur between the stakeholders at different articulation levels of the innovation system (Lanahan and Feldman 2015).

As a background to strengthening the innovation system, the next generation of STI public policies in the DR must define alternative financing sources, by considering fiscal incentives and tax benefits (from the perspective of new productivity-oriented fiscal frameworks), and by promoting medium- and long-term productivity and competitiveness behaviors that support productive transformation. For example, one financing alternative to support STI policy implementation could be to use mining royalties to foster the development of a knowledge-based economy. This economy can operate as a replacement industry that incorporates the principles of medium- and long-term intergenerational equity, based on the rationale of environmental externalities caused by mining activities. A review of the best practices of linking mining royalties to STI policy implementation in the context of LAC countries can be found in Iizuka et al. (2017).

Finally, the possibility of a new *STI policy* configuration in terms of an independent organizational setting to support STI policies should be among the considerations of agendas that prioritize innovation as one of their principal axes aligned with the NDS. Such frameworks must incorporate the technological challenges currently faced by the DR in terms of its adaptation and mitigation of the effects of climate change on productive sectors such as tourism, agriculture, energy, transportation, etc. Meanwhile, such frameworks, as the next generation of STI policies, should deal with challenges in terms of achieving sustainable development goals and promoting more resilient economic growth, while avoiding the risks of the middle-income trap in which the country's economy may already be ensnared.

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Supplementary data

Supplementary data is available at *Science and Public Policy* online.

Notes

1. A comprehensive approach to the STI governance would cover a closer look to the *polity* (the political organization in terms of actors such as ministries and public agencies at different scales and levels); the *politics* (or the interactions between actors, power struggles, as well as to the discourse construction and

political action) and to the *policy* (planning process, objectives and policy instruments) of science and technology in the DR. This article is focused on the *policy* (Varone et al. 2005).

2. A detailed review of the Dominican Republic's scientific production from the 20th century to the first decade-and-a-half of the 21st century can be found in the doctoral dissertation by Riggio (2017). This work analyzes the production of knowledge (from a multi-dimensional perspective) by taking into account organizations, sectoral and geographical distribution, and different sources and diffusion mechanisms.
3. A detailed review of this time period, with the most relevant studies on the industrialization and development of Latin America and the Caribbean, can be found in 'Industrialization in Latin America: From the "Blackbox" to the "Empty Box,"' published by the Economic Commission for Latin America and the Caribbean (ECLAC 2016).
4. During this period, economic liberalization, commercial openings, and modernization of the state were considered synonyms. An early review of this symbiosis of economic reforms with the modernization of the state and its impact on development policies can be found in Gore (2000).
5. A relevant review of the reforms of intellectual property systems in Latin America and the Caribbean, with details on their impact on trade opening and STI policies, can be found in Park (2002).
6. An additional review of the institutional framework and STI bodies in the Dominican Republic, which considers the roles and functions in terms of strategic management (policy level), operational management (level of implementation), and the provision of services (support entities and suppliers of goods and services for firms).
7. The formulation process was financially supported by the 'Innovation Program for the Development of Competitive Advantages' (FONDEC) (IDB loan 474 OC/DR) of the CNC.
8. A review of the term 'policy mix', including its origin, complexity, and epistemic validity, can be found in Flanagan et al. (2011).

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