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Exploração de novos conceitos em política de inovação

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resumo:

Neste artigo identificamos seis conceitos de política de inovação que, embora não sejam novos, têm surgido recentemente na literatura especializada como principais organizadores de intervenções nos campos da ciência, tecnologia e inovação. São eles: (i) falhas de mercado, (ii) políticas de especialização inteligente, (iii) combinação de políticas, (iv) política de inovação transformativa, (v) política orientada para a missão, (vi) política de inovação holística e complexa. Esses conceitos estabelecem critérios e modalidades de intervenção sob um conjunto de pressupostos sobre a lógica da política, a forma e o processo da política. Na maioria dos casos, sua base conceitual e teórica é implícita, vaga ou eclética; No entanto, há um traço comum: eles são fortemente baseados na experiência prática. Analisadas através da lente da tríade design-implementação-avaliação, as experiências políticas bem-sucedidas tornam-se a principal razão para futuras implementações. Argumentaremos que fazer isso lhes permite evitar conflitos iminentes nas intervenções políticas. Neste artigo, analisamos os seis conceitos, especialmente em relação a: i) o processo de política, ii) a forma de intervenção e iii) a lógica da política. Esta análise permite elucidar a posição de cada conceito em um mapa mental, a fim de desvelar seus pressupostos políticos e ideológicos.

palavras-chave:

Até ciência; tecnologia e política de inovação; lógica política; processo político; convenções.

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9.1 Discussão teórico-metodológica

1. Introduction

Over the last decades basic consensus on the necessity of public intervention in science, technology and innovation has emerged in order to achieve structural change and development goals (OECD 2015). In this context, science, technology and innovation (STI) policies aim at the development of scientific-technological and organizational capabilities, as well as to the application of these capabilities with the purpose of fostering productive transformation. These policies would allow both developing and developed countries to achieve structural change to cope with different goals such as social inclusion, competitiveness, productive development and decarbonization as a strategy to mitigate climate change.

However, there is great heterogeneity of intervention experiences and broad frameworks that support them which leads to a fruitful debate on STI policies. These experiences and frameworks do not converge into a single and consensus theory of intervention in STI. By contrast, profound differences in the main conceptual frameworks guide policy making nowadays, especially as regards: i) the policy process, from its conception to implementation and evaluation (Flanagan, Uyerra, and Laranja 2011), ii) the policy form, which establishes the way in which instruments aim to accomplish results, and iii) the policy rationale, which justifies interventions.

In this paper we identify six concepts of STI policy that have emerged recently in specialized literature (although some of them are not new) with the aim of guiding policy makers in their intervention decision. These concepts cover a wide range of theoretical frameworks from mainstream to heterodox approaches under the following labels: (i) market failure (Bloom, Van Reenen, and Williams 2019), (ii) smart specialization policies (Foray 2016; Foray, David, and Hall 2011; Foray, McCann, and Ortega-Argilés 2015; Boschma and Capone 2015), (iii) policy mix (Soete and Corpakis 2003;), (iv) transformative innovation policy (Schot and Steinmueller 2018; Fagerberg 2018), (v) mission-oriented policy (Mazzucato 2015; Chiang 1991), (vi) holistic and complex innovation policy (Borrás and Edquist 2019; Magro and Wilson 2013; Frenken 2017). These emerging concepts establish criteria and intervention modalities according to a set of assumptions about policy process, policy form and policy rationale. Each of these new concepts seeks to become a policy paradigm in STI, that is, a shared model of reality that guides policy makers in designing policy instruments, ways of implementation and in the identification of the intervention basis and justification (Diercks, Larsen and Steward 2019; Carson, Burns, and Calvo 2009; Hall 1993).

A common thread among most of the concepts is that they are strongly based on practical experience, analyzed through the lens of the design, implementation and evaluation triad. Successful implementations of policy instruments become the main reason for subsequent implementations. However, the theoretical bases are, in most cases, vague or eclectic. Without discussing the theoretical consistency, they include perspectives that range from mainstream economics, with concepts of market failure and second best, to the theory of innovation and technological change, grounded on the Schumpeterian and evolutionary bases.

This situation could resemble Stokes's definition of (2011) Edison's Quadrant¹, where the practical value of knowledge is emphasized no matter its scientific basis. In this article we will discuss that the fact that most of the new concepts analyzed fall within Edison's quadrant means that they minimize the importance of the theoretical framework from which the intervention is conceived. That is, theory is not required, only experimentation, and often effectiveness becomes the main and only reason for policy implementation. As a result, the new concepts take a step backwards to avoid deep political discussions on the assessment of social problems, priority settings and on the whole process of public policy making. For this reason, we will affirm that being in Edison's quadrant means being in an unquestionable field in order to avoid coping with conflictive aspects of policy making such as ideological assumptions, or priority setting required in building mental models to imagine structural change.

In this sense, we identify a broad new convention that we call Edison's convention, which values practical knowledge over theoretical knowledge. This convention is intertwined with both: i) an old

¹ Stokes defines Edison's quadrant as one in which applied knowledge is relevant no matter its theoretical grounds as opposed to Bohr's quadrant in which theoretical knowledge is important and to Pasteur's quadrant in which both theoretical and applied knowledge are considered relevant.

convention which claims that each instrument should address a market failure (one-to-one mapping). As a result, the intervention modality will be toolkit-oriented and the assessment will focus on the estimation of policy additionality, that is to say, net effects that would not have occurred in the absence of public intervention and ii) new emerging concerns focused on the role of STI policy facing climate change, or other major societal challenges.

The main objective of the article is to build a mind map on which emerging concepts regarding innovation policy may be located. The main question that motivates the article refers to what policy makers should know about these concepts when designing innovation policies. Other questions are: why are most of the emerging concepts located in Edison quadrant? Why do the emerging concepts avoid explaining and making theoretical frameworks explicit? And finally, how do these concepts differ when inquiring about the intervention process, policy form and rationale?

In the second section, the main aspects of each of the six concepts are described, including origin, theoretical roots, and the implicit assumptions on how innovation systems work as well as the assumptions on political and ideological domains. In the third section, the new concepts are analyzed based on the results of the following axes: i) the intervention process, ii) the form of the intervention and iii) the policy rationale. Finally, in the fourth section, we present the main conclusions and discuss the relevance of the new concepts for the design of sciences, technologies and innovation policies, particularly as regards developing countries.

2. New concepts in innovation policy

In this section, we briefly describe the six emerging concepts regarding STI policy. The identification of these concepts was based on a literature survey of specialized journals, including documents of international organizations and policy briefs (OCDE, European Commission, IADB), special issues published in innovation policy journals and new academic books on innovation policy. As regards the timeframe, it goes from 2008 (considering the last economic crisis as a turning point) until today. We present each concept as originally defined, adding some elements so as to understand their emergence and similarities.

2.1 Market failures

Neoclassical economics prescribes policy interventions only in the presence of market failures. Based on second best theory (Lipsey and Lancaster, 1956), policy interventions are desirable when one or a set of restrictions prevent the achievement of optimal Pareto conditions. This concept is also followed by the mainstream literature on innovation studies and STI policy, although this literature criticizes several assumptions made by the canonical neoclassical economics. In particular, mainstream literature on innovation studies acknowledges that research and development have a profound effect on economic growth and structural change and that public support for these activities has been decisive for technological change in most countries (Jones, 2015).

If the main rationale for intervention has been the presence of market failures in innovation activities, these failures are massive and systemic due to path-dependency in the knowledge accumulation and capability building processes, and also as a result of knowledge spillovers and interactions among actors in learning processes. In other words, recognizing that knowledge is not merely information allows us to consider the idiosyncratic aspects of learning, while recognizing that knowledge and information are, to some extent, public goods means that intervention has a role to play due to market failures. If we add the aspects associated with the inherent uncertainty of the process of technological change and the information asymmetry among firms whose main assets are intangible, it is easily noticeable that failures are the norm rather than the exception in the field of innovation.

Mainstream innovation economics considers these issues and to a certain extent it differs from other mainstream economics like new trends in macroeconomics that follow dynamics-stochastic general equilibrium models (Dosi, 2013), the assumptions of which include perfect rationality, efficient markets and a price vector as the only relevant information of the economic system, discarding, among other issues, strategic interactions, non-linearities and out-of-equilibrium system operation.

However, when designing STI intervention, the mainstream is not far from the forms of

intervention in other areas. It is characterized by planning the intervention within the framework of a toolkit, where each tool seeks to fix a market failure, without considering the interaction possibilities among instruments, and systemic interactions among firms and policy makers, each of them having its own agency issues. The idea of considering each intervention into a constraint context of each particular objective, scope and design is coherent with a search for measuring impacts in a very precise manner. Experiments in econometrics, for instance, are identified (or mainstream recognizes them) as the only way to accurately evaluate the impact of a policy, and they are limited to seeing the direct effects of policies in a short-term horizon which is restricted to the terms of their explicit objectives.

Bloom, Van Reenen and Williams (2019) identified that this toolkit comprises fiscal incentives, public subsidies for research through large public programs, resources available for human capital formation, intellectual property, or competition policies including regulatory institutions to open the economy to external competition. The authors also include other instruments, although they provide evidence of the weaknesses they faced, due to the opportunistic behavior of firms or the state failures in their implementation. Those other instruments are patent boxes², policies for innovation in SMEs or mission-oriented ones.

Within the set of instruments analyzed, the concept of failure offers the policy rationale. This is so in the case of subsidies for innovation, justified by the spillovers of R&D (Research and Development) expenditure, or of public research and training programs for human resources focused on the creation of public goods with positive effects on the productive system of the entire population.

2.2 Smart specialization policies

The concept of Smart Specialization arises from the group of experts “Knowledge for Growth” that advised the European Commission in science and research in 2008. The objective of this group was to think of alternative public policies to help in the dissemination of the results of public investments in the areas of knowledge and innovation, especially as regards horizontal technologies. In this context, authors such as Foray have encouraged productive diversification towards activities in which there is a related variety, guided by self-discovery. The key is not to select new sectors but to encourage the development of clusters around general-purpose technologies that determine the relevance of already existing horizontal activities. The idea is that these new technologies are powerful enough to promote the search for new applications by entrepreneurs in the sectoral domains in which they are already operating.

The theoretical backgrounds to the approach are eclectic. They can be found in the classic Smithian growth theories and in the commercial specialization based on Ricardian comparative advantages. They are also linked to authors associated with the theory of innovation who emphasize the presence of increasing returns on knowledge, the presence of knowledge spillovers (Jaffe, Feldman) and the rigidities in labor markets that prevent changes in the specialization patterns. The already mentioned backgrounds are also related to the ideas of productive development, ranging from Marshallian externalities, industrial districts and flexible specialization (Piore and Sabel), to the positions of Foray and Boschma regarding the related variety, the works of Hidalgo and Hausman on specialization in commerce and works on neoclassical space economics (Kugman and Venables).

A key policy recommendation of this group is to concentrate financial aid for innovation on cross-cutting activities instead of sectors, so that the comparative advantages of each region can be exploited as a result of the application of new technology developments to already existing activities. In this sense, Smart Specialization policy design is oriented towards horizontal and neutral policies and a positive assessment of the pre-existing comparative advantages in territories or regions. Policies are oriented to the search and exploration of new technological knowledge applied to pre-existing productive structures with the aim of encouraging related diversification towards knowledge-intensive activities.

In this context, it is perceived that the Smart specialization concept seeks to be broad in its ability to adopt theoretical contributions without accurately exploring the coherence between them. In any case, despite seeking to be part of the evolutionary or neo-Schumpeterian approach, it is closer to neoclassical economics, which can be noticed when it indicates that intervention should not be oriented towards the

² It implies lower taxes on the benefits derived from patents.

selection of sectors but towards facilitating the entrepreneurial activity of "Occurrence of discovery" of new sectors. For this, the policy should remove regulatory restrictions and set appropriate incentives.

An important issue of the approach is that, as it is oriented to the design of regional policies, it highlights the importance of specialization (since the diversification of small economic regions undermines efficiency), it also recognizes that not every specialization is positive. The concept of smart specialization maintains that it is important to incorporate knowledge and go through related diversification processes that may integrate new technologies.

In smart specialization concept planning is completely absent. At best, it may be considered as regards targeting general-purpose technologies. However, the smart specialization strategy can be considered as a mix of modern industrial policies and policies that favor innovation from a bottom-up (entrepreneurial discoveries), transparent (monitoring and evaluation) and flexible (abandoning programs that fail) perspective. The emergence of this policy approach is not independent of the political and economic context of disruptive change at global level.

Smart specialization aims to generate related variety processes in regions (Foray, 2011 and 2013 and Boschma and Capone 2015) that may lead to a process of transition and modernization towards new activities, which requires the identification of missing capabilities. The more related technologies are in the industries of a region, the greater the opportunities to give rise to processes of related variety. However, they can also give rise to processes of unrelated variety, which implies the emergence of new sectors. Some scholars supporting this concept focus on three rationales for policy intervention: market failure, coordination problems and directionality (Foray, (2019).

2.3 Policy mix

The idea of policy mix according to which public intervention must strategically combine various instruments to respond to systemic failure emerged in the past decade.

Several scholars in developed countries (Soete and Corpakis 2003, Guy et al, 2009; Nawelaers 2009; Cunningham et al., 2013) stress that "policy mix" involves the articulation between STI innovation policy and other public policies that have a direct or indirect impact on STI. In this way, they expand the STI policy horizon to other topics such as human resource training, intellectual property, social development, environment and health. The problem-solving oriented nature of this approach demands a systemic view that contemplates different levels of governance, multiple actors and a strategic articulation between different policy instruments.

The main scholars that support this concept define the policy mix as a specific combination of tools that interact explicitly or implicitly as regards innovation, whether in terms of quantity or quality of public and private spending on R&D. According to these scholars, perfect models or optimal policy tools that may serve all purposes are not available. By contrast, instrument mixes are contextual and relative to the nature of the problem being addressed. The idiosyncratic characteristics of each innovation system in terms of the capabilities and linkages of its actors, structural characteristics, and the institutional and cultural arrangements around the state-market-society relations are determined within specific concrete regions. All these factors explain why the one-size-fits-all formula is irrelevant.

The policy mix theoretical framework is based on the innovation systems approach, according to which intervention is justified by the presence of systemic failures. According to this approach, the effectiveness of the instruments designed to identify and solve STI problems in isolation³ is limited by the interdependencies and feedback that govern the system dynamics.

From this perspective, the mix includes active involvement of the public sector with an impact on the levels of investment in research, development and innovation. In this context, innovation policy goes beyond typical STI actions and includes other dimensions that influence innovation processes, such as active involvement of the public sector with an incidence on the levels of private R+D expenditures, development and innovation in the context of social, health or environmental policies. Consequently, the theoretical justification for intervention stems from imbalances and mismatches in innovation system. However, these mismatches are not considered to be the product of market failure.

The novelty of this approach lies in the fact that innovation policy is designed outside the STI.

³ For example: low private spending on R&D or problems with technology transfer within the context of the firm-university-relationship.

Therefore, the approach considers the influence of policies defined in other areas over innovative performance in an economic system (Guy et al, 2009). Thus, for example, policy mix analyzes and identifies the implications in terms of innovation and the generation of new knowledge associated with climate change mitigation.

Thus, at theoretical and applied levels, policy instruments of any field or area with and impact on STI (science, technology and innovation) are considered. Then, tools which raise different objectives and uneven timing can generate unplanned dynamics. In other words, this concept seeks to understand the impact on innovation coming from feedback between instruments that belong to several areas in a policy mix.

In their planning of intervention, policy mixes recognize the complexity of learning processes and the effects that past and present policy actions have on them. Thus, planning faces limits derived from the competencies of public actors and current policies that have various layers stacked over time. In this way, the policy mix approach recognizes that policy actions inevitably interact in a flow of events and activities. Then, interaction between policies is a fundamental feature that should be taken into account.

2.4 Transformative policy

The design of transformative policy stems from the conventional objectives of the classic innovation policy focused on competitiveness and growth and focuses on other aspects of social and human development (Fagerberg 2018; Schot and Steinmueller 2018; Diercks, Larsen, and Steward 2019). It focuses on issues such as climate change or other social challenges such as resource scarcity, food security or population aging. This concept argues that this type of approach requires going beyond actions exclusively centered on the field of the ministries of science, technology and innovation and include new actors such as the ministries of health, agriculture and energy.

The emergence of this new concept is associated with the so-called Paris agreement regarding the implementation of new policy actions that guide innovation towards a global transition in favor of a low-carbon production model (Fagerberg 2018). This new approach involves moving from an economic policy agenda to a social policy one. While in the previous concepts (policy mix and smart specialization) policy actions were focused on industrial policy aimed at economic activity, competitiveness and growth goals, in the concept of transformative policies national prestige, strategic priorities and social challenges are at stake. The domain of politics is broad, and the logic lies in recognizing the positive and negative effects of innovation.

The turn of transformative policy is explained by growing criticism of the productivist role of innovation policy, partly responsible for the environmental impact of the current production model, based on fossil energy with direct effects on climate change. In this regard new great social challenges were identified as policy goals. It implies a kind of re-edition of what became known as “the big ideas” in science and technology, also considered by the mission-oriented policies concept as well (see next section). However, transformative policies do not completely exclude the conceptual framework of innovation systems theory, which continues to be useful so as to understand how innovation policy is oriented to articulate actors and institutions that comprise the system. Transformative policy proposes putting the systems approach at the service of productive transformation compatible with environmental sustainability rather than at the service of productivity growth and competitiveness.

This approach stresses that transition to sustainability is a positive sum game due to the numerous opportunities offered by radical technologies. The transformative policy supporters argue that shifting from non-renewable energy to renewable energy and ICT are means for change that will allow humankind to avoid relying on fossil energy, though it will require to develop innovations in areas such as energy storage and distribution, transportation, electrification, in business models and in the public sector.

According to Schot and Steinmueller (2018), advances in transformative innovation policies require a total change in the conception of innovation policies: they consider that a leading role of private firms in the innovation process is debatable. In contrast, they support the idea that public actors may have a more active role when they are promoted by national strategic policies that include public procurement and public and mixed companies. This issue is associated with the recent change in the

Oslo Manual in which the definition of innovation goes from being restricted to the introduction of a new product in the market to a wider definition that considers that users may have access to a product, without assuming it has been bought or sold in markets but, for example, provided by public institutions.

In relation to innovation policy, other authors consider that the way in which governance is designed, implemented and exercised is important (Edler and Fagerberg 2017). From this perspective, the transformative policy should deal with the creation of new solutions as well as their exploitation and dissemination, particularly including the large amount of feedback generated in the learning process (novelty generation and diffusion), that is, in the complete cycle of the process of innovation.

The promoters of this new policy argue that there is no lack of resources and capabilities to generate transformative innovation. The relevant issue is how to mobilize those capabilities.

2.5 Mission- oriented policy

Although the roots of mission policies go back to the second postwar period, usually linked to defense objectives, in recent years they have been reconsidered as an effective perspective to mobilize resources to face new societal challenges such as climate change and population ageing (Mazzucato, 2015 and 2016; Mowery, 2013; Foray et al., 2012; UNCTAD, 2017; Karo and Lember, 2016; Coenen et al., 2015). In this new context, old definitions such as Ergas' (1987), which make a distinction between mission-oriented policies and diffusion-oriented ones, have been taken and reformulated under a new concept of policies in which non-neutrality, direct intervention and demand instruments are revalued to cope with increasing international technological competition. This includes the emergence of new players with real mastery to compete for the dominance of cutting-edge technologies in Europe and the United States.

Paradoxically, Ergas' works, along with other contemporary authors, such as Chiang (1991) and Chesnais (1993) sought to vindicate diffusion policies against mission ones, due to certain risks and low diffusion. According to Ergas (1987), mission-oriented policies are those that pursue the development of technical capacities in strategic fields. They are characterized by the generation and exploitation of radical technological change - Big Science, Big Technology - (Chiang, 1991) in which the State assumes a leading role in decision-making regarding the technological trajectories to be adopted and promoted (Ergas, 1987). Policy objectives are designed and determined by the public agencies that finance research and development and centralize project monitoring and evaluation. These agencies, in turn, articulate with other government areas to attain the proposed objectives, be it defense agencies in the original model, or energy, health, and environment agencies, under the new missions. In this context, mission policies are usually focused on large projects, from which multiple, technological and productive spillovers are expected. In other words, they aim at radical inventions that move the technological frontier and then reach diffusion through applications in multiple fields. In this context, innovation system literature that emerged during the 90s stated that missions constituted high-risk bets, which contrasted with low-risk strategies based on diffusion policies, promoted by a group of Asian countries with catching-up objectives instead of forging ahead (Abramovitz, 1986).

In the last ten years there has been a revival of mission-oriented policies, both from an academic perspective and a public management perspective. As regards the first one, Mazzucato (2015) demonstrates the key role of the State in identifying sectors with innovative potential and in promoting their development. According to this author, public policies should not only lead to solving market failures but, mainly, to the creation of new markets in areas where the possibilities of learning and externalities generate multiplier effects on economic activity. These ideas comprise, as theoretical background, a significant part of developmentalist perspective, especially regarding the identification of strategic, industrializing sectors with the potential to generate productive linkages (Hirschman 1958) and affect the productivity of other activity branches. In this context, mission-oriented policies are characterized by promoting technological and industrial development based on the articulation of high impact efforts that potentially spill towards a diversity of productive sectors. In this type of policy design, a selection of sectors and technological trajectories is required, thus direct market intervention makes sense.

From a public management perspective, a growing interest in mission-oriented policies can be noted, particularly in public procurement as a tool for promoting innovation. For example, in the Lund Declarations (2009 and 2015), promoted by the European Commission for Research, Science and Innovation, together with other European institutions and organizations on science and technology, the

importance of tackling major social problems is highlighted, as an articulating strategy of efforts in science, technology and innovation. The specific actions of the 2015 Lund declaration highlight the importance of connecting the generation of knowledge with users, pointing out that a greater impact on these great social challenges will be achieved through greater involvement of the public sector. Mission-oriented policy strategy points at demand policies that have been insufficiently used despite the fact that they have great potential to meet major social challenges.

Furthermore, in its report on Science and Technology Policy (OECD, 2015: 11), the OECD recognizes the importance of direct and vertical measures to promote innovation, arguing that direct measures to support research and development, such as public procurement and funds allocated to mission-oriented R&D projects, can be particularly effective in the case of young firms that lack the capacity to finance long term innovation projects.

2.6 Holistic innovation policy

The holistic perspective of innovation policy has recently been developed by Borrás and Edquist (2019), but its background can be found in the work of several scholars since mid 90s (Metcalf, 1994, Witt 2003, Borrás and Edquist 2013; Edquist 2014; Magro and Wilson 2013; Brennen and Broekel, 2019).

This perspective requires understanding “innovation processes and their socio-economic context” considering complexity (Borrás and Edquist 2019). These scholars argue against partial or fragmentary perspectives that set aside the side effects and byproducts that appear after the implementation of a policy, or the social and institutional web of interests and arrangements that are built in the policy design and implementation process. They argue that other concepts such as policy mix or transformative policy do not stem from an adequate theoretical framework that guides the design of innovation policies. Eventhough these concepts expose their theoretical affiliation (in innovation systems), strong pragmatism prevails in both design and policy rationale.

When considering the multiple aspects that affect design, implementation process and policy effects, the holistic approach is closer to the complex systems theory applied to the Schumpeterian and evolutionary economics (Robert and Yoguel, 2016). This theoretical proximity allows the understanding of innovation processes and their determinants. Likewise, the contributions made by institutionalist and political science scholars make it possible to discuss the policy process and understand the context of policy rationale making and the design and implementation of tools. All these perspectives give rise to considering policy in terms of what is known as the theory of economic policy making considered as a learning process (Witt, 2003). Unlike other approaches, holistic innovation policy does not consider that these aspects are strictly technical; on the contrary, it clarifies the political and social reasons on which it is built.

The approach proposes a three-stage method that leads to its “policy rationale”. First, consistent with the approach of complex systems, the dimensions of innovation systems are described. Second, research is done regarding the problem generated by policy interventions. Third, the blockages and barriers present in implementation are identified. Thus, steps two and three are consistent with a complex system approach as soon as it is recognized that the intervention may have unintended effects or unanticipated blockages in the original design, which stem from the interactions and feedback triggered by the intervention. Therefore, policy rationale does not aim to achieve an optimal state or benchmark as regards the functioning of the system, but to support its dynamics so that it causes the desired effects without imbalances. Policy rationale is studied by the theory of economic policy making which arises from the public choice theory which argues that intervention is motivated by market failure and institutional failures.

At the same time, the holistic innovation policy approach acknowledges the political dimensions associated with prioritizing these “desired effects” which must be socially constructed. For instance, there are administrative dimensions, linked to budgetary restrictions or the latent disputes between government areas or the tensions between different sectoral interests and between public and private actors that will be solved along the policy process and with stakeholders’ participation.

In this way the approach promotes a perspective of the policy process which is far from rational and mechanistic conceptions that characterize other concepts discussed above. This approach recognizes that: (i) policy makers face limited resources, information problems, and uncertainty (Lindblom 1959),

(ii) the decisions of policy makers are crisscrossed by political systems that determine (although not efficiently) the priorities for intervention (Forester 1984), (iii) institutional inertia transforms policy into a path-dependency process, in which past experiences affect current ones and policies overlap as geological layers that are difficult to dismantle. According to Witt (2003) during the policy making process, the positive and normative knowledge that informs the actions of the agents involved can change as a result of experience and induced inventive learning” (Witt 2003) This scholar stresses that “the evolutionary approach adds a new perspective that emphasizes behavioral and contextual elements in the design and application of policy”.

In this context, the approach emphasizes that there are no ready-to-use instruments or solutions that apply equally to every context. A key element within the holistic innovation policy concept is the role assigned to demand side. In this sense, this concept is closer to the mission-oriented policy concept (Mazzucato 2015; 2016; Borrás and Edquist 2019; Edler and Yeow 2016) and it differs from the transformative policy one, where sustainability failures justify interventions. Another difference regards agency, considered by transformative policies though to a lesser extent in the case of mission-oriented policies. Finally, the policy design under this paradigm should consider the articulation between State demand- driven design and bottom-up stakeholders- driven design.

On the other hand, due to its affiliation with the complex systems theory, intervention requires both identifying missing capacities and connections, and the way existing capacities and connections interact and generate or block the development of feedback processes and to emergent properties. In this context, policy should be experimental and aim to create conditions for the emergence of innovation, produce change in the specialization pattern and give place to structural change.

The holistic perspective identifies certain weaknesses of the other new concepts: i) the strong distance between a generic theoretical framework and intervention specificities and ii) the fact that innovation policy is not also addressed from a theoretical perspective.

Not surprisingly, the self-interest assumption triggers a rather critical attitude towards instrumental (or “technocratic”) views of the role of the government. The basic assumptions of the complex system and evolutionary perspectives provide the point of departure: the hypothesis of bounded rationality and its corollary, the hypothesis that, due to learning, the knowledge constraints of both policy makers and the agents affected by the policy can systematically change in the process of policy making Witt, 2003).

Being a concept closely related to complexity perspective, strong differences can be found between those scholars who stress that the emergent properties are related to coordination and those who stress the relevance of change. Both groups consider that institutional variety, defined as “a variety in the norms, customs, and rules” (Srinivas 2020), through which the economy functions, is very relevant to the theory of economic policy- making supported by this concept.

Variety matters because institutional change does not occur singly. Combinations of institutions matter; institutional variety includes markets and other institutions, requiring combinatorics (Amable 2000) and heuristics (Srinivas 2012).

Innovation policy is at the center of the policy-oriented evolutionary economics literature (e.g., Metcalfe 1994, Cantner & Pyka 2001, Smith 2018) and related fields such as regional policy (e.g., Lambooy & Boschma 2001), environment policy (e.g., Faber & Frenken 2009) and literature on the relevance of institutions.

3. Mind map of innovation policies: criticism and triangulations

In this section we present a comparative analysis of the six concepts of innovation policies stylized in section two, based on the idea that the specific form of policy process, policy form and policy rationale assumed in each concept will depend on: i) the theory of innovation and technological change, ii) the ideas and preconceptions about the functioning of the political system and the management processes, and iii) the degree of agreement with broad convention established around innovation policy, in which practical knowledge is valued over the theoretical one.

In this sense, in order to find differences and similarities among the six concepts, we propose to analyze them considering these three axes of analysis: i) the intervention process, ii) the form of intervention and iii) the policy rationale (See table 1).

Table 1 - The six concepts – axes analysis

	Intervention process			Intervention form			Policy rationale	
	Agency	Rationality of policy makers	Rationality of economic actors	Toolkit	Objectives and tools	Neutrality	Failures	Plan & Directionality
Market Failure	No	Low	Perfect	Yes	Micro	Yes	Market	No
Smart Specialization	No	High	High	Yes	micro	Yes	Systemic	No
Policy Mix	No	High	High	Yes	Macro	No	Systemic	Yes
Transformative innovation policy	Yes	High	Bounded	Partial	Macro	No	Sustainability	Yes
Mission oriented	No	High	Bounded	Partial	Macro	No	No	Yes
Holistic innovation policy	Yes	Bounded	Bounded	No	Experimental	No	No	Yes

Source: Own elaboration based on literature revisited.

Any policy intervention proposal begins even before design, since pre-existing conditions directly and indirectly affect it. Just as these conditions affect the design of instruments, they also affect the nature of the implementation and the form and even rationality behind the evaluation of public policy.

Within the process of policy-making we consider three dimensions: (i) the degree of voice and agency, (ii) the degree of rationality and capacity attributable to policy makers and (iii) the degree of rationality and capacity attributable to private actors.

Regarding the intervention form, each concept proposes different models in which decisions are combined around instrument and policy goals. In relation to instruments or resources, these can refer to a specific inventory of empirically validated instruments, recognized in the idea of intervention toolkit (ready to use) or the ability to develop new ad-hoc instruments, tailored to particular conditions, grounded on an explicit theoretical framework. Regarding the intervention goals, the form of the intervention considers the relationships between them, and in particular, their side effects on the system. The form of policy making considers three dimensions. First, the extent to which the paradigm considers the existence of a toolkit containing pre-validated instruments. Second, the articulation between objectives and instruments, under three possibilities: (i) a micro type, in which each objective is linked to an instrument shaping a one-to-one relationship, (ii) a macro type, in which many instruments deal with one or several objectives in a complex web of interrelationships, and (iii) an experimental one, in which there is no evidence linking objectives with instruments. Third, the neutrality issue, as a particular type of relationship between objectives and instruments, in which side effects should be avoided (neutrality).

Finally, “policy rationale”, which refers to the fundamental reason for intervention. It is defined by two key dimensions: the conception of politics as a response to failures in the “natural” behavior of the system, which justifies interventions and the need for planning or directionality as a means to meet policy objectives.

3.1 The policy-making process

Voice and Agency

A concept of innovation policy accounts for voice and agency when the policy design that emerges from them explicitly takes into account the conflicts of interest and the different perspectives that arise from the implementation of the policy. One can even consider the anticipation of the agents before the communication of a new instrument by public institutions or interest groups with power to influence the policy agenda.

In this case, the concept of policy stems from a complex conceptualization of the policy process, which is not restricted to Edison's convention, but considers the voice of different public and private actors that can promote or block a policy. The conflicts of interest that can derive from its design should recognize the need for complementary instruments that may mitigate the conflicts caused by the same process of policy conception.

This type of recognition is linked to the assumption of neutrality. It means that public intervention in the functioning of markets and innovation and learning systems is not merely about fixing deviations, but can assume a central role in both transformation and search of disequilibrium. However, the position of each concept surrounding these issues presents ambiguities that require a deeper discussion.

The questions discussed in the second section allow us to see that the concepts "holistic" and "transformative" take into account the idea of voice and agency. In the "holistic innovation policy" concept, the integration of social science contributions and the broad conception of economic systems embedded in social and political structures recognize the possibilities of conflict between public and private actors regarding the development model, and between private actors as regards the possible redistributive effects of the policy.

On the contrary, in the neoclassical paradigm this aspect is practically absent, at least in the context of innovation policies. The abovementioned aspect considers that a good policy design must preserve relative prices and avoid generating redistributive effects.

The mission-oriented policy concept lacks agency. In spite of recognizing possible redistributive effects, the mission-oriented perspective relies on the ability of the policy maker to impose the new structure and to postpone and delay latent conflicts.

The policy mix and smart specialization concepts appear as intermediate situations. Most of the literature on policy mix places policy makers in the role of translators of rational logics that do not take into account the agency they generate (Flanagan et al, 2011). In this way, policy mix generates a new source of complexity since the agency of the public actors involved in some instruments is limited by the agency exercised by the rest of the actors. In other words, the criticism of the policy mix is that it is not a matter of simply combining "doses" of various instruments but of evaluating their effects on the set of feedback and blockages that exist in production and innovation systems.

Rationality and capacities of policy makers

The axis associated with the degree of rationality and capabilities attributable to policy makers is also considered within the process of policy making. This raises two questions: i) to what extent the concept of policies foresees the possibility that policy makers achieve a design aligned with the intervention strategy and, ii) if they are able to execute policy design and adapt it in case of deviations from the original plan.

In this context, while some concepts recognize restrictions in capacities, access to information and rationality of policy makers, other concepts have an optimistic perspective as regards policy maker capacities. To some extent, this axis partially overlaps with the one related to agency and voice. The lack of alignment between objectives and results may be explained by limited rationality, incomplete information or estimation of capacity restrictions. This happens within a context of high uncertainty or, simply, a lack of alignment between the objectives of the policy and the objectives of the public agent, which may refer to their permanence in office or their personal professional development plan. In this case the agency problems would not be due to conflicts of interest between public and private spheres as in the previous axis, but a conflict of the public within the public sphere.

Few concepts recognize in the figure of policy makers more than disinterested bureaucrats. On the contrary a lack of reflection on the intentionality of the different actors and their capacity predominates.

Within the new concepts of politics, in policy mix, transformative policy, mission-oriented and Smart specialization there is a tendency to consider the State (or policy makers) as an organization that acts with perfect rationality (Sharp, 1997), which leads to minimizing the effects of agency and deficiencies in competencies and capacities of the actors.

Optimism prevails in policy frameworks that emphasize the need to implement complex policies with multiple instruments that must be gently combined for the success of the original design. These approaches consider that policy design is a complex task and intervention requires high public

capabilities. However, optimism or lack of problematization of the extent to which these capacities are available in public agencies might be an important limitation when comparing original designs with the results obtained.

At the other extreme, mainstream literature is pessimistic when stressing the problems of asymmetric information and the limited capacities of state planning, which can be explained by the presence of state failures. In this case, this recognition leads to minimizing intervention, only possible when it does not generate distortions and only recommended when it is assumed that the Pareto optimum cannot be achieved due to the presence of market failures.

An intermediate position can be found in the holistic concept. Although this concept admits the limitations of public actors, it does not invalidate intervention. On the contrary, intervention becomes even more complex as it is recognized as an experimental process subject to necessary revisions due to the unpredictability derived from non-linear relations in the implementation and in the connections between government offices. According to these approaches, it is necessary to consider how to build capacities in the state for the intervention, especially when taking into account a dynamic approach which stems from the idea that the state can be conceived as a set of agencies with poorly specified limits, which generates a variety of not very distinctive functions (Schmitter, 1985).

Rationality and capacity attributable to private sector actors

This dimension refers to how and on the basis of what information and competencies each concept of intervention explains that private economic actors make their decisions. At one extreme, some concepts explain that the actors make their decisions based on a set of pre-established beliefs and knowledge built up over time, therefore, they are strongly heterogeneous and interdependent. At the other extreme, other concepts explain that the actors make their decisions automatically on the basis of an infinite set of information with perfect calculating capacity. Ultimately, this dimension responds to the different hypotheses that can be made as regards the rationality of economic actors and the adequacy of policy instruments to these hypotheses.

When perfect rationality is assumed as the sole determinant of private elections, policy design will be limited to correctly setting incentives, so that actors may adjust their decisions. This is the case of the mainstream paradigm, but it is also present to a certain degree in the cases of policy mix, transformative policy and Smart specialization. In all these cases there is no deep problematization about how instrument designs should anticipate limited rationalities of the agents. The possible differential reactions to the same incentive scheme, in the case of policy mix, could cause serious difficulties in adjusting complementation between converging instruments.

On the contrary, the holistic concept focuses on the question of capacities and interactions within the competition process, recognizing the possibility of strong heterogeneities in capacities and responses, especially when low competences and capacities of firms constitute barriers to access policy instruments. According to these approaches, it is not enough to establish a new incentive scheme for the system to automatically adjust to the policy goals (i.e increase private R+D expenditure), but rather requires complex interventions that involve profound changes in the way organizations learn and build their capacities throughout their path dependence.

3.2 Intervention form

Policy as a toolkit

This dimension differentiates cases in which the concept of intervention explains that there is already a toolkit that policymakers have for intervention. It also includes the cases in which toolkit either does not exist or is not tested and must be generated ad-hoc. The idea of politics as a toolkit is fundamentally present in the mainstream concept and in two heterodox ones (Policy Mix and Smart Specialization), although combining different doses of instruments. In the last two concepts, toolkits are pre-existing. Policy makers only have to combine doses of existing instruments. It differs from the mainstream case in that they consider the complex relationships between instruments and objectives. From an opposite perspective the Holistic concept is identified, the toolkit does not exist since the intervention has a strong experimental component that does not require starting with already known instruments.

In an intermediate situation, mission-oriented and transformative policy concepts can be

identified. In both cases, the toolkit starts with already designed instruments that are enriched by intervention and by the new instruments that policy deploys. As stated by Flanagan et al (2011) in several concepts, but especially in policy mix, policies start with tools that already exist in the kit. In this sense, the concepts that come from an existing toolkit do not need to analyze the instruments they propose to mix. They do not identify the role of actors, instruments and institutions. Therefore, they lack a dynamic perspective of policy which should include: i) the connections between institutional and private actors that limit the idea of a “toolkit”; and ii) the understanding of the interface among actors, instruments and institutions. A criticism to the intervention that comes from the presence of toolkits is that the development of instruments should be seen as a social process that has a strong political nature.

The relationship between objectives and instruments

In any concept of intervention, the relationship between instruments and objectives plays an important role. Thus, there can be both multiple instruments for one target and multiple targets for one instrument. This refers to the degree of interrelation between problems and policy priorities and the conception of intervention at microeconomic, mesoeconomic and macroeconomic levels. By micro conception of intervention we mean that policy design sets its priorities in isolation and attacks them with specific instruments without spills or undesired effects expected in its implementation. In macro design, the intervention is expected to address a complex problem, the results of which emerge from the policy implementation process and therefore can lead to conflicts. Consequently, the relationship between various objectives (economic growth, employment, defense, health, environment) and instruments, and especially how the objectives should be balanced constitute key questions of political nature: (i) does the intervention solve a problem or does it present multiple problems which should be prioritized based on social and political agreements? (ii) are there complementarities and synergies between individual instruments? (iii) do the instruments adapt to the innovation system and to the public administration capacities?

In the mainstream intervention model and to a lesser extent in the Smart specialization one, there is a microeconomic linearity between objectives and instruments: an instrument serves an objective. On the contrary, in the other concepts, especially in Policy Mix, Mission-oriented and Transformative Policy, there is a complex web of interactions among objectives and instruments. This refers to a macro vision in which several instruments serve an objective. However, it is not clear if the side effects caused by agency or voice are considered. Finally, in the case of the holistic concept, the consideration of experimental intervention itself can generate non-linear relationships between objectives and instruments.

Neutrality

Neutrality refers to the fact that the instrument(s) deployed in the intervention do not modify the relative prices of the factors or the products and do not give rise to unplanned results. In this direction, a neutral policy does not modify the agent optimization processes and does not aim to generate a winner selection process, either in sectors or in firms. From this perspective, neutral policies tend to be horizontal while non-neutral policies stand out for being vertical.

Considering this definition of neutrality, only the mainstream and Smart Specialization concepts can be identified as neutral. In the second case, this is explained by its orientation towards generating processes of related variety without qualitatively transforming the specialization profile. On the contrary, the rest of the concepts discussed in this article are not neutral because they aim to generate processes of structural change that would not be reached without intervention.

In sum, according to the three dimensions that account for intervention form (see Table 1), we see that both, the mainstream and Smart specialization concepts, stand out for positive responses in each of them. The concept of holistic intervention is aligned with negative responses to that type of intervention. The remaining three concepts are in an intermediate situation. While none of them are neutral or have macro characteristics, they differ on the relevance assigned to the toolkit, relevant in the policy mix and partially relevant in the other two (Transformative policy and mission- oriented policy).

3.3 Policy rationale

Intervention guided by failures

This axis distinguishes the approaches that consider a performance benchmark of the socio-economic system from other approaches. Intervention guided by failures refers to the policy approaches that justify intervention in the presence of failures, either in relation to the optimal functioning of markets (such as the mainstream approach) or “desirable” conditions of innovation systems (system failures of evolutionary approaches). Systems could move away from those optimal or desirable conditions due to limitations in the components of the system or in its interconnections. This situation is observed in the cases of Policy mix and Smart Specialization. Finally, sustainability failures are also considered in Transformative policy, which justifies intervention in the fact that markets will not solve environmental issues like climate change on their own. Intervention for failures, including market failures, usually assumed that policy makers as well as economic actors have rational behavior, and their choices are not affected by partial information or uncertainty. In this sense, Uyarra et al (2011) suggests that multidisciplinary elements especially political science ones should be added as regards the effects of feedback and blockages that exist in the various production and innovation systems.

Directional or planning-guided intervention

Planning-guided intervention makes it possible to distinguish between those approaches that consider the directionality of intervention as a key tool of politics and other approaches in which planning has no place. In this second group the mainstream and the holistic concepts coincide for different reasons. While the first one explains that a plan distorts the allocation mechanisms, the holistic concept, based on complexity theory, explains that in a context of uncertainty in which agents have bounded rationality the policy must be experimental. Therefore, holistic innovation policy overcomes the “plan” but not a necessity of directionality in the interventions motivated by social and political agreements. Flanagan et al (2011) stress that learning and unlearning processes of actors are key. Therefore, they propose to understand the policy design and implementation process as it is and not as we would like it to be. In other words, understanding the design of policies as a probabilistic and non-deterministic perspective allows us to understand the process rather than letting us predict results. According to this concept, the evolutionary world is much more complex and less prescriptive than the mechanistic world, so policies cannot be analyzed independently of the process required for their construction (Kay 2006).

4. Conclusions

In this article we have discussed some theoretical foundations of six “concepts” in innovation policy which seek to become organizers of intervention in the field of innovation policy. We have analyzed each of these “new concepts” from 3 axes and 8 dimensions. The three axes include: i) the conceptualization of policy process, ii) the policy form and iii) the policy rationale. This allowed us to investigate the theoretical bases of the concepts, which are sometimes contradictory and eclectic.

The eight dimensions allowed us to identify in each concept the assumptions made about the policy context including the determinants of learning and innovation processes, but also the type of rationality of the different stakeholders, their behavior and their capacity to influence the policy design process.

We have found similarities and differences of the six concepts in terms of the eight dimensions that constitute (i) the policy process, (ii) the policy forms and (iii) the policy rationale. First, it can be seen that Market failures and Complexity & Holistic concepts do not share any of the eight dimensions considered. It means that they differ not only in the intervention process, the intervention form and policy rationale but also in all of the dimensions that define the three axes. For example, their perspective differs radically when considering the presence of agency and the rationality of policy makers and private actors, the existence of toolkit, relationship between objectives and tools, neutrality, intervention justified by failures and relevance of plan or directionality. Besides, Transformative and Mission-oriented policies are closer to Holistic than to Market failures policies. While Mission -oriented policies as well as market failure policies do not care for agency of actors or strategic behavior, Transformative, as well as Holistic do. On the contrary, Mission and Transformative policy concepts share half of the dimensions with the Holistic ones. This means they have a stronger relationship with the Holistic theoretical framework than those closer to mainstream economics. Mission -oriented policies and Holistic share: i) bounded rationality of private actors, ii) non neutrality of policy, iii) no intervention

justification by means of failures and (iv) the necessity of a plan or directionality in policy interventions. Besides, Transformative and Holistic policy share: i) the presence of agency, ii) bounded rationality in private agents, iii) non neutrality and iv) plan or directionality.

Smart Specialization is close to Market failure concept since they share five out of eight dimensions. The market failure concept considers perfect rationality of private agents, and bounded rationality of public agents while the smart specialization concept also assumes high rationality in public agents. On the other hand, failure-based intervention is present in both concepts though under different forms. In the market failure concept there are markets which fail, while in the smart specialization concept (as well as in other systemic concepts) systems fail. The other five dimensions are the same in both concepts.

At the opposite extreme of the spectrum, Holistic, Transformative Policy and Mission –oriented policy concepts are closer among them. These cases share several dimensions. Transformative and Mission -oriented policies share six of the eight dimensions. They differ only in the presence of agency and failures, which are relevant dimensions in Transformative but not in Mission.

Finally, the policy mix concept connects both extremes. It shares two dimensions with the market failure concept (the lack of agency and relevance of toolkits), and two dimensions with the holistic one (the lack of neutrality and the relevance of plan or directionality). Policy mix position, related to market failure and holistic concepts, reflects a more eclectic theoretical framework when it is compared with the other concepts.

Each concept is characterized by adding different commitments based on a closer approach to political science. It allows us to understand the complex web of interests on which the institutional framework of policies is built. Despite the underlying theoretical affiliation (explicit or implicit), in most cases, a strong share of pragmatism is imposed in the intervention, mainly Edison's convention. This may be the true generalized consensus that is present in all the proposals.

In the introduction we have argued that, in Stokes' terms, the new concepts are mainly located in the Edison's quadrant. Bringing Stokes's ideas to the social sciences, specifically to the political ones implies recognizing that much of innovation policy is moving into an uncertain field where some kind of experimentation is necessary. But there is a convenience reason as well. Theoretical and ideological assumptions are related though avoided by a technocratic perspective of public intervention. Therefore, being located in the Edison's Quadrant is not merely a preference of practicality over theory, but practicality avoiding deep debates about social and political functioning.

In the two dimensions used for building policy rationale, the presence of a plan or directionality or interventions to overcome failures, we found the main arguments to understand why most of the concepts are located in Edison's quadrant. As public action moves away from ideal functioning (i.e. Pareto optimum, or a strongly articulated innovation system) according to which policies are constituted as corrective actions to overcome failures, we are closer to recognizing disputes and tension among actors. In that case, intervention arises from a plan that implies directionality that makes intervention non-neutral. Any plan exceeds ideal types since it recognizes the presence of conflict as well as the need for arbitration in them so as to foster the building of a sustainable development model.

The majority of new concepts implicitly or explicitly refer to the notion of neutrality, which implies the impossibility of generating structural change processes. Some authors are focusing on industrial policies as tools for productive transformation, in a context of competition between global chains. Rather, innovation policy adopts an individual perspective, in which interdependencies generated in international trade are absent. In this context, future lines of research should include a notion of innovation policy integrated into industrial policy. In turn, industrial and innovation policies should be integrated into a development policy. Likewise, it is necessary to conceive the innovation process in competition processes and creative destruction framework, which have strong limitations in developing countries.

In developing countries, the need for industrial and innovation policies is fundamental because their productive structures are heterogeneous and disarticulated. In this context, structural change path implies implementing non-neutral policies capable of generating processes of unrelated variety.

Exploration of new concepts in innovation policy

Abstract:

In this paper we identify six concepts of innovation policy which, although not new, have recently emerged in specialized literature as main organizers of interventions in the science, technology and innovation fields. They are: (i) market failures, (ii) smart specialization policies, (iii) policy mix, (iv) transformative innovation policy, (v) mission-oriented policy, (vi) holistic and complex innovation policy. These concepts establish criteria and intervention modalities under a set of assumptions about policy rationale, policy form and policy process. In most cases, their conceptual and theoretical basis is implicit, vague or eclectic; however, there is a common thread: they are strongly based on practical experience. Analyzed through the lens of the design-implementation-evaluation triad, successful policy experiences become the main reason for further implementations. We will argue that doing that allows them to avoid imminent conflict on policy interventions. In this paper we analyze the six concepts especially regarding: i) the policy process, ii) the intervention form, and iii) the policy rationale. This analysis allows us to elucidate the position of each concept in a mind map in order to unveil their political and ideological assumptions.

Keywords: Science technology and innovation policy; policy rationale; policy process; conventions.

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