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Regional Innovation Policy and Multilevel Governance in Developing Countries: Between a Rock and a Hard Place

ABSTRACT

Innovation policy is increasingly conceived as the shared responsibility of national and subnational governments, yet most countries are struggling with multilevel governance. This paper provides an overview of how different countries are dealing with regional innovation policy and of the institutions and tools used for national-regional coordination. The focus is on discussing the policy implications for developing countries, which have decentralized their innovation policies more recently than developed countries, but face more acute challenges with respect to critical mass and institutional capacity. These challenges call for a sequential and cautious approach to decentralizing innovation policy, seeking economies of scale and avoiding wasteful duplication across regions, while introducing methods to ensure that devolution of power is accompanied by capacity building in regional governments. Governments of developing countries are also advised to be cautious when using a regional innovation policy approach as a tool to reduce cross-regional income gaps. This is because policy efforts to counterbalance the natural trend toward agglomeration of innovative activities in core regions might lead to inefficient allocation of public funds.

1. INTRODUCTION

During the last two decades, regions and cities around the world have become more active in developing their own innovation policy agendas. In the words of Florida (1995: 528): *"Despite continued predictions of 'the end of geography', regions are becoming more important nodes of economic and technological organization in this new age of global, knowledge-intensive capitalism."* Building on the "national innovation systems" framework (Freeman 1987; Lundvall 1992), the literature on "regional innovation systems" underscores the importance of subnational governments as catalysts and coordinators of regional actors' innovative activities and interactions (Cooke 2001; Howells 1999). The regional innovation systems approach is inspired by neo-Marshalian theories of industrial districts and clusters, in which regional policy is deemed to be critical to foster "agglomeration effects" and "interactive learning," while at the same time to bring scientific knowledge closer to local industrial needs (Koschatzky and Kroll 2009; Laranja et al. 2008; Rip 2002).

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While a regional approach to innovation policy can be positive in many respects, aggregate empirical studies have failed to find a significant relationship between decentralization and a nation's innovative performance (Taylor 2007). In addition, despite the growing trend toward decentralization, it would be misleading to conclude that regional level policy is replacing policy at the national level. The two tiers should be conceived, rather, as interdependent and complementary. The notion of "multilevel governance" refers to sharing responsibility over policy design and implementation between different administrative and territorial levels. Central governments maintain their key role in building

institutional framework and defining national strategy, all the while seeking coherence and economies of scale and avoiding wasteful duplication. In addition to top-down devolution, powers in innovation policy are also shifting upwards toward supranational organizations, particularly in the European Union. The need for interregional cooperation adds another layer of complexity when the appropriate demarcation of innovation policies does not coincide with the existing administrative boundaries. For example, Shanghai's innovation system encompasses parts of the surrounding provinces to create a larger functional urban area. In sum, a major challenge for policy-makers is to streamline the interaction of different levels of government in order to improve the efficiency of innovation policy.

Studies have sought to understand how public policies in developing countries have contributed to the emergence of subnational "knowledge hubs" (e.g., Chaminade and Vang 2008); however, the literature on multilevel governance of innovation policy has mostly focused on developed country experiences. This is partly because developing countries have only very recently decentralized their innovation policies. This paper aims to address this gap by exploring the challenges associated with regional innovation policy and multilevel governance in developing countries. Many of the opportunities and challenges of regional innovation policy do not depend on a country's level of development, but developing countries' regional innovation systems often face higher levels of diversity, income inequality, and institutional instability than do similar systems in developed countries (Cassiolato and Martins 2000). The following section provides an overview of how regional innovation policy unfolds in different countries and of the institutions and tools used for national-regional coordination. Section 3 discusses the implications of regional innovation policy for developing countries and Section 4 presents some concluding remarks.

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2. REGIONAL INNOVATION POLICY AND MULTILEVEL GOVERNANCE: TRENDS AND CHALLENGES

Traditionally, regions have only been involved in innovation policy in some federal countries, such as Germany, Switzerland and the United States. But regions in more centralized countries, such as France, Sweden, Poland, Japan and South Korea, among others, have progressively gained new policy competences in this area. However, it should be noted that the scale and scope of decentralization differ markedly from country to country (and even from region to region within a country) depending on their particular technological profiles, institutional frameworks, and historical trajectories. For example, in 2009, the subnational share of total R&D expenditure by the public sector ranged from around 5 percent in Austria and Denmark to around 20 percent in Spain and South Korea, 50 percent in Germany and China, and almost 80 percent in Belgium (OECD 2011). Note, however, that budget allocation (fiscal decentralization) does not necessarily coincide with decision-making power (political decentralization), because budgets can be decentralized, while decisions are taken at the central level. In other words, the role of regions can be a passive one, limited to the implementation of nationally defined policy initiatives, or an active one, with regions acting as participatory partners in national policy processes and co-financing policy initiatives, or even serving as independent policymakers that develop their own strategies and devote their own resources to projects that they select.

Many middle-income nations, especially the larger emerging countries, have also decentralized their innovation policies in recent years. For example, in China, the central government has focused on fundamental research, while the provinces and municipalities have often concentrated on diffusion of technology and supporting industrial clusters (Box 1). Similarly, although regions in Russia have very limited policy competences and resources available for R&D, their relevance in innovation related support has increased substantially, with a focus on technology parks, incubators and venture funds (Spiesberger 2013).

Also recently, in Latin America, larger countries like Brazil, Mexico, Colombia, and Chile have begun to move toward a regional approach to innovation policy. For example, in Brazil, the decentralization of innovation

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BOX 1. THE DECENTRALIZATION OF INNOVATION POLICY IN CHINA

China recognized the need to decentralize innovation policy during their sweeping economic reforms in the late 1970s and have substantially accelerated innovation policy efforts during the last decade. Currently, subnational governments contribute more than half of the country's total public expenditure in R&D and innovation, but the division of policy responsibilities between the subnational and national levels is not clearly defined by law. In practice, the central government controls basic research and areas of national interest (e.g., national defense, health, security). The subnational governments oversee technological development and diffusion of existing technologies. The central government allocates 70 percent of its science and technology budget to R&D, while subnational governments allocate just around 30 percent and use the bulk of their budget to other types of innovation support.

Subnational governments primarily influence innovation policy by developing special economic zones, scientific parks and industrial clusters. China's establishment of special economic zones in the early 1980s provided incentives for export-oriented industrialization and tested the market economy and new institutions, while facilitating the absorption of modern technologies and management practices. More recently, in an effort to further develop technology-based clusters, Chinese regions and cities have launched science parks, incubators, and extension services, which has encouraged local universities to engage in research and to establish industrial linkages, induced venture capitalists to invest in SMEs, and attracted R&D from multinational firms. The national government has sometimes intervened in cooperation with regional governments by selecting the most promising special economic zones and science parks around the country and providing them with additional funding and support. For example, since 1988, the national government has selected and certified 84 national science parks through the Touch Programme. Regional governments continue to offer a range of complementary policies for science parks, including free land allocation, infrastructure and facility support, as well as enhanced public services to companies located in the parks. In order to be admitted into the science parks, firms must be certified by regional regulators as "high-tech enterprises."

The process of decentralizing innovation policy in China is facing significant difficulties. For example, in addition to the science parks designated at national level, the proliferation of provincial and local initiatives has given rise to a "race-to-the-bottom" characterized by increasing competition based on tax incentives and subsidies. Li (2003) argues that an unclear division of labor among the different levels of government has sometimes resulted in inconsistencies between regulations adopted at different levels as well as in a less coherent implementation. According to a report by the World Bank and DRCSC (2013: 168): "The challenge for China is to arrive at a national innovation strategy that is cost efficient, optimally decentralized, rationally sequenced, and urban-centric."

Sources: Li 2013; Zeng 2011; OECD 2009a; World Bank and the Development Research Center of the State Council 2013.

policy began in the mid-1980s with the establishment by the National Research Council of twelve science parks in cooperation with state and municipal governments and universities. Later on, with the development of networks of business incubators, innovation policy shifted further from a centralized approach to more bottom-up, regional and local initiatives in cooperation with universities (Etzkowitz et al. 2005).

In lower-income countries, however, the decentralization of innovation policy remains at its infancy, not least because science and innovation policy is underdeveloped due to very limited available funds. Central governments across Africa dominate science and innovation policies even in the most advanced countries, like South Africa. However, South African provincial governments have developed the authority to implement regional development initiatives that have begun to target innovation, like the Blue IQ Initiative (Gauteng Province) and the Cape IT Initiative (Western Cape). In Morocco, despite having a predominately centralized science and innovation policy, the national government is increasingly adopting a decentralized perspective on innovation policy, including new initiatives to develop technology clusters and science parks in selected regions. For example, the Innovation Cities program, launched in 2011 to boost innovation in four cities (Casablanca, Fez, Marrakech and Rabat), emphasizes the building of new research centers and business incubators in the vicinity of universities in order to foster university-industry cooperation (Basrhir 2011). These examples suggest that although decision-making still remains highly centralized, cities and regions are also gaining ground as the loci of innovation policy in Africa.

2.1 The Division of Responsibilities Between Levels of Government

The levels of differentiation within innovation policy instruments can vary largely from country to country. Borras and Edquist (2013) classify the different innovation policy instruments as "regulations" (e.g., intellectual property rights, statutes of universities, public research organizations, bioethical regulations, etc.), "economic transfers" (e.g., *en block* support to research organizations and universities, competitive research funding, tax exemptions, investment in venture capital, etc.), and "soft instruments" (e.g., voluntary standardization, codes of conduct, public-private partnerships, etc.). Sometimes the division of power between national and regional governments is clear; in other instances, those powers are shared. For example, in most countries, the national government wields exclusive power over the intellectual property rights regime, while both the national and regional levels share responsibility over developing scientific infrastructure. A specific type of policy instrument, such as matching grants, can be used simultaneously at both levels, but must have different targets. For example, the national level could target large-scale projects that involve the production of new knowledge, and the regional government could target smaller programs that focus on technology diffusion. Building on a review of the literature, Table 1 provides a tentative framework to assess a country's multilevel division of innovation policy competences. Note, however, that in light of the large differences across countries, these classifications do not intend to be prescriptive or indicative of the most efficient approach.

Drawing clear lines of separation between national and regional innovation policy competencies, however, would be counterproductive since certain policy instruments are best executed if they are shared among different levels of government. This marks a more cooperative approach that can benefit from complementary strengths around a single public policy issue. A typical example of a national policy that encompasses the regional level is the centrally coordinated cluster initiatives that provide support to selected regions. These initiatives result from a bottom-up program design driven by a competitive call for proposals open to all regions (Eickelpasch and Fritsch 2005). In France, for example, the Poles of Competitiveness program ("Pôles de Compétitivité") was launched in 2005 to support research-intensive clusters throughout the country. Within this program, clusters deemed to be internationally significant receive additional funding from the national level, while those that are not considered a national priority are left in the

TABLE 1 National vs. Regional Responsibilities in Innovation Policy

	MORE OFTEN NATIONAL	MORE OFTEN REGIONAL
Mode of innovation	Knowledge generation	Knowledge diffusion and exploitation
Target groups	Public research labs, universities, large firms	Small firms, startups, spinoffs
Infrastructure	Universities, public R&D labs	Incubators, science parks, special economic zones, technology transfer offices
Regulations	Intellectual property rights	Building permits, infrastructure development
Economic transfers	Tax deductions, large grants to new R&D projects	Smaller grants to fund business innovation
Soft instruments	Standardization, codes of conduct	Networking and brokerage services
Human capital	Higher level education, postgraduate scholarships	Technical training, lifelong learning, internships
Linkages	International linkages, scientific collaboration	Public-private partnerships, cluster development

Sources: Chaminade and Vang 2008; Karo 2012; Koschatzky and Kroll 2009; Laranja et al. 2008; OECD 2011; Perry and May 2007; Ritzen and Soete 2011; Todtling and Trippl 2005; World Bank 2010.

hands of regional governments. In the 1990s, Germany, through the BioRegio program, sought to stimulate its biotechnology sector by promoting clusters in selected regions. The central government shepherded the program's creation, finance, administration, and selection of target regions. However, the policy was essentially regionalized as each region designed and implemented its specific plan.

In practice, a survey of OECD countries revealed the lack of a clear division of powers between national and regional innovation policies and a large overlap in the kinds of instruments used (OECD 2011). Overlapping national–regional policy instruments creates synergies only if both levels complement one another. This complementariness can arise in the way the instruments are structured in terms of their target actors or across the range of service needs. Overlapping instruments leads to negative results, however, only if they create redundancies by failing to distinguish among target groups or topics. For example, in a study of Korea's regional innovation policy landscape, Hassink (2001) noted that a lack of coordination between national and regional governments resulted in fragmentation and overlapping functions. The proliferation of public support programs at different levels can lead to higher transaction costs, more bureaucracy, and confusion among target firms. To address these risks, national and regional governments can develop mutually acceptable eligibility and reporting criteria, clear mechanisms for co-financing policy instruments, and clear systems of

continuous information sharing. For instance, national-regional coordination should seek to streamline and harmonize administrative templates and procedures for requesting R&D incentives, in order to reduce transaction costs for target firms and researchers. With the information they compile about regional policy instruments, the central government can create information platforms, or "one-stop shops," for grant applicants. These might include, for example, websites listing national and regional R&D grants, regional cluster development initiatives, science parks, etc.

In general, the appropriate level of intervention for a given innovation policy instrument depends on several different factors, including the type of targeted actors, the efficiency of the innovation delivery mechanisms, and the strategic scale of the instrument, among others. Moreover, different regions have different administrative capacities to implement innovation policies. Even if regions have sufficient budgets and competencies, some can still lack public employees with the necessary skills and experience. Conversely, central governments tend to operate closer to the knowledge frontier due to their size, international networks, and capacity to attract qualified workers. However, returns to scale could also decrease, and, especially in large countries, the center could get overwhelmed. The key, then, is to match allocation of authority with administrative capacities.

Central governments should ensure the coherence of regional innovation strategies by seeking economies

of scale and reducing fragmentation. In the absence of an appropriate central oversight, decentralization can result in inefficiencies and governance problems. Ritzen and Soete (2011) argue that if all regions strive to achieve research excellence, the majority will miss the mark, often leading to the creation and subsequent decline of overambitious research infrastructure in locations with weak endowments, also known as the "cathedrals in the desert" syndrome. In addition, the central government should be attentive to possible gaps in combined regional strategies that could result in neglected policy areas at any level of government. In particular, investments with benefits that expand beyond the regional constituencies will tend to be underfunded without central government intervention. For example, if no region sets out to specialize in medical technology, the central government should consider necessary the creation of at least one public medical technology research center and launch a national competition to fund it.[1]

National governments often struggle to create innovation policy that promotes balanced technological development across economic levels and geographic regions. The positive link between technological innovation and economic growth implies that in order to close income gaps across regions, policies should seek to close innovation gaps. The problem is that most national innovative efforts tend to be heavily concentrated in a few core regions. And, this concentration is nearly insurmountable due to the cumulative nature of technological capabilities, economies of scale, agglomeration effects, and indivisibilities. This self-reinforcing process often aggravates regional divergence, which comes with important economic and political implications. In sum, central governments charged with allocating innovation funding must balance promoting scientific excellence through regional competition and concentrating resources in the core regions, on the one hand, and encouraging convergence and equality among their regions by nurturing lagging regions, on the other (Crespy et al. 2007). The Russian Federation struggles with this dilemma as discussed

in Box 2. Also in China, the central government is attempting to revert mounting income inequalities across regions by providing more support to innovation in underdeveloped regions. For example, the Revitalization Plan for Higher Education Institutes in Mid- and Western China (2012–2020) funds R&D projects in order to strengthen universities in less developed regions.

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[1] The so-called 'subsidiarity principle' refers to the intervening role of the next higher level of government in the case that the lower level in the federal system does not intervene to address a societal need (Bermann, 1994).

2.2 Institutions and Tools for National-Regional Coordination

The discussion in the previous section emphasized the importance of national-regional coordination. Such coordination should be fostered at all stages of the policy cycle, from strategic formulation to policy design, implementation, monitoring and evaluation. In this section we further discuss some of the main coordination tools and provide country examples to illustrate the policy options available.

Consultation Bodies, Territorial Representatives, and Agencies

The decentralization of innovation policy is often accompanied by the creation of new national-regional institutions for dialogue and agenda-setting that are adapted to specific circumstances within each country and that build on existing institutional frameworks. These may take the form of policy councils made up of high-level representatives from the national and regional governments or territorial representatives from the relevant ministries and national agencies. For example, in the Czech Republic, the national innovation agency CzechInvest has established regional offices that support innovation policy implementation. These agencies have played an important role over the past few years in supporting the development of science parks and cluster initiatives across the country's regions. In Mexico, formal national-regional consultation occurs via the National Conference of Science and Technology (S&T), which also promotes regular dialogue between national and state level S&T councils. Moreover, the National Council for S&T (CONACYT) has established regional delegations that liaise with subnational governments and oversee the implementation of federal programs (OECD 2009).

In addition to these kinds of formal institutional processes, most countries also use national-regional working groups and *ad hoc* meetings as instruments of dialogue and coordination. Moreover, a frequent practice is to invite regional representatives to the working groups and national innovation strategy development consultation processes, which provides a forum for building consensus and strategic alignment.

Regions and localities are also increasingly creating their own autonomous innovation agencies to implement regional innovation strategies that act as counterparts to the national agencies and ministries responsible for innovation policy. Some regions have established new, autonomous agencies, while others rely on the evolution of preexisting structures, like regional development agencies. An example of the former is Ruta N, a local agency established in 2009 in Colombia's second largest city, Medellin, in order to execute the city's new Strategic Plan for Science, Technology and Innovation 2011–2021, which seeks to boost entrepreneurship, business innovation, and cluster development. An example of the latter is the Agency for Economic Development of the Greater ABC Region in Brazil, which was created in 1998 with a broader regional development mandate, but has adopted a stronger focus on promoting innovation in recent years (Zhang 2010). In particular, the agency has established two business incubators and several programs to promote innovation and to upgrade the regions' automobile parts, computer hardware, and plastics clusters. The agency's board of directors is comprised of representatives of the regional governments, the seven regional municipalities, business associations and firms, higher education institutions, and trade unions. This helps improve not only vertical coordination, but also public-private partnerships and horizontal coordination among the different stakeholders of the regional innovation system.

A more recent trend is the creation of multilevel agencies for the joint design and implementation of innovation strategies. A case in point is Innovation Norway, a new national agency launched in 2010 and jointly owned by the regional (41 percent) and the central (51 percent) governments. The new agency has increased regional involvement in the design and funding of innovation policies, while providing an opportunity to pool funds and exploit complementarities and synergies across regions.

Project Co-Financing and National-Regional Funds

In some instances, co-funding mechanisms are associated with individual, large-scale projects, such as scientific

infrastructure; whereas, in other cases, they have a more open and longer-term scope. There are many possible design options, but the general idea is to share responsibility over the selection and funding of science and innovation programs in order to create synergies and strengthen policy coherence. A possible mechanism for this is to establish a matching grants system in which the central government agrees to match every dollar, up to a certain limit, that regional governments dedicate to innovation projects on the condition that private firms also match the contribution (World Bank 2010).

Project co-financing is a widely used instrument to develop strategic investment projects and infrastructure whose benefits span beyond the regional constituencies. For example, a public research center in a region can collaborate with firms from other regions in the country. Similarly, a university from one region can accept students from another region on a reciprocal basis and their graduates can end up working in different regions. As referenced earlier, such initiatives tend to be underfunded without central government investment. Under these circumstances, project co-financing addresses fiscal imbalances and encourages convergence of objectives. The decision of the central government to co-finance projects is often the result of a national competitive solicitation open to all regions.

In China, for example, the National Science and Technology Infrastructure Program provides a roadmap for investing in research infrastructure by fostering inter-regional integration and sharing infrastructure. During the 11th five-year-plan period (2006–2010), the government invested around $US 275 million out of which 20 percent came from subnational governments (Li 2013). Likewise, in Spain, a national program has selected a limited set of so-called "singular technical-scientific installations" in regions that are co-financed with national funds. These are comprised of large investments to build unique public research labs and equip them to engage in cutting-edge scientific research. In 2007, the Spanish regional and national governments agreed to create 24 new "singular technical-scientific installations" thru 2015, in addition to the 37 existing ones. A major advantage of the

selection process was that it fostered information sharing among regions to avoid overlaps.

In other instances, governments have promoted the creation of joint national-regional trusts to fund innovation projects for regional actors on a competitive basis. For example, Mexico's "mixed funds" (Fondos Mixtos, FOMIX) were jointly established in 2002 by the central and regional governments as a trust fund for science and innovation projects. As of 2013, more than 35 mixed funds had been established across the Mexican States and also in some municipalities (Ciudad Juarez, La Paz, Puebla). This system was meant to foster innovation capacity at regional level and to better articulate federal and regional support for innovation. Each fund has its own technical committee and evaluation commission to issue calls for proposals and select projects for funding within their respective regions. The total budget for the 2001–2012 period was around $US 580 million, of which 45 percent came from the regional governments and 55 percent from the central government. However, according to a review of this program by the OECD, in many cases, the system suffered from a lack of well-articulated demand from the states, especially from the less developed ones (OECD 2009b).

Other governments have created new funds to finance the implementation of regional innovation strategies, which often requires regions to develop their own innovation strategies. The regional government, in cooperation with a central government evaluation commission, selects and finances regional projects that comply with national goals. The Colombia's Fund for Science, Technology and Development, for example, has financed regional innovation initiatives since 2012 through mineral resource royalties (Box 3).

National-regional contracts

Many countries rely on contracts or bilateral agreements between central and regional governments with regard to their mutual commitments, the assignment of decision-making powers, the distribution of financial contributions, and mechanisms to monitor and enforce contracts

BOX 3 COLOMBIA'S NEW ROYALTIES FUND FOR STI

Although some of Colombia's 32 regions (or "Departamentos") were already engaged in the design and implementation of science, technology and innovation (STI) policy, the scale and scope of regional involvement in this area has increased substantially since 2012, following the creation of a new fund for STI. New 2011 legislation governing state royalty administration from national mineral resource exploitation (including oil) contains a provision to allocate 10 percent of the royalties to the new fund for STI. Currently, this represents around $US 500 million annually, which is about the same amount that the country invested in R&D prior to the establishment of the new system. The royalties fund for STI is distributed to regions based on a formula that considers population, unemployment and poverty indicators, so that poorer regions get more funding per head than richer ones. The Fund is administered by Colciencias, the R&D funding agency of the central government, but the regional governments select the projects they would like to fund in their regions. A committee established by Colciencias approves selected projects after ensuring that they conform with the rules, expected quality, and feasibility. Ultimately, regional governments need to develop their own innovation strategies to better select the most likely projects to be awarded monies from the royalties fund.

This new system has strengthened regional autonomy in innovation policy and has promoted a more systematic design of regional innovation strategies. However, early experience also points to a number of challenges. The first problem is that even though a country's less advanced regions receive a larger part of the funds, they lack the absorptive capacity required to design and develop the right kind of projects to promote innovation. In order to address this issue, Colciencias has established an Office of Regionalization that has supported so far the drafting of 27 regional development plans for STI, which serve as a reference for project formulation. A more profound challenge of this new fund is its charge to balance two conflicting strategies: the first is oriented around scientific excellence and performance, and the second aims to reduce regional disparities. Another problem is the lack of thematic coordination across regions and between regions and the state in which each region pursues its own strategies in an isolated manner. For these reasons, Colciencias is currently trying to stimulate collaboration among regions as a way to better align regional strategies and to help underdeveloped regions to catch-up by learning from more advanced regions. However, up until now, the results have been disappointing because the central government cannot practically impose interregional collaboration, and regions have a tendency to allocate all of the available funds only within their own boundaries (i.e., to local firms and universities without involving partners from other regions). The risk is that this may lead to fragmentation, wasteful duplication, and other inefficiencies.

Sources: Cuervo and López 2013; OECD 2014.

(OECD 2010). Contracts are used for co-financing and joint programming innovation policy instruments. Furthermore, if properly designed, they can hold levels of government accountable to act beyond political mandates, which contributes to the continuity and stability of innovation policy strategies regardless of the political cycle. National-regional financing contracts take many forms. Sometimes they finance specific, large-scale scientific infrastructure whose benefits spill over regional borders. In other instances, they coordinate, manage and finance broader innovation policy strategies. The OECD has highlighted the "relational" nature of contracts, which means that they can play an important trust-building, information-sharing, and capacity-building role that facilitates multilevel governance (OECD 2010). Unlike a general call for proposals, relational contracting is more interactive and serves as a vehicle for managing a cooperative relationship over time.

For example, since 2009, the Spanish central government has established contracts ("convenios") to improve national-regional coordination in support of R&D and innovation in areas of common interest. In this way, the Spanish government provides preferential loans at low interest rates for regional investments in science and innovation until 2015, with a 10-year pay back period. Within the contract, each region commits to its own quantitative objectives for meeting the national plan's 2015 targets. A Joint Monitoring Commission with representatives at both levels monitors progress. In France, relationships between the regional authorities and the central government are organized by seven-year contracts called State-Region Project Contracts (*Contrat de Projet État-région*). These broad contracts cover all policy areas and set out the financial transfers provided by the central government to meet regional policy objectives, with a specific chapter dedicated to research and innovation. These contracts also regulate the development of the Poles of Competitiveness program mentioned earlier. Through these kinds of programs, the French government is shifting toward a network-oriented and bottom-up approach to innovation policy (Barmeyer and Kruth 2012).

3. IMPLICATIONS FOR DEVELOPING COUNTRIES

As argued above, many developing countries are struggling with multilevel innovation policy governance, even more so than developed countries, since they are often confronted with higher levels of regional diversity, income inequality, and institutional shortcomings. These challenges call for a sequential and cautious approach to decentralizing innovation policy, introducing methods to ensure that devolution of competences is accompanied by capacity building in regional governments. It also requires the development of new institutions and national-regional coordination tools, such as those discussed in Section 2.2. The rest of this paper further discusses some implications for regional innovation policy in developing countries.

3.1 Coupling Regional Innovation Strategies with the Broader National Strategy

The first step for regions that embrace an active role in innovation policy is to develop a multi-annual strategy that determines the main problems and defines a set of priorities in the short-, medium-, and long-term. The strategy should reflect the broader national context and avoid unnecessary duplication and fragmentation of efforts, as well as seek opportunities for joint programming with the central government and neighboring regions. Regional and national innovation strategies should be coherent in terms of their objectives, target indicators, and policy instruments, but this is often hard to achieve (see Poland's recent experience in Box 4). Forming coherent policy means that regional governments link their strategies with those at the national level. The central government should also design its national strategy after jointly considering the strategies of the regions.

A key element of regional innovation strategies is to decide in which sectors or technologies to specialize. For this purpose, the notion of "smart specialization" is becoming increasingly influential in Europe and other regions around the world.[2] In essence, this approach advocates for concentrating resources in a limited set of priority areas that are clearly aligned with regional strengths and competitive advantages.

BOX 4. SMART SPECIALIZATION AND NATIONAL-REGIONAL COORDINATION IN POLAND

Poland is a unitary state divided into 16 regions ("voivodships"), each with substantial regional autonomy. In order to receive funds for innovation during the current 2014–2020 European Union (EU) financial perspective, Poland had to design new Research and Innovation Strategies for Smart Specialization at both the regional and national levels in compliance with the new European Commission framework. A World Bank team assisted the Polish government in this process, and their report provided a useful illustration of the challenges associated with national-regional coordination of innovation policy (Piatkowski et al. 2014). In general, there was considerable overlap and lack of coordination across regions, and between the regional and the national strategies. This is at least partially because Poland developed many of the regional innovation strategies before finalizing the national innovation strategy. The World Bank report argues that "system consistency requires some general structure and sequencing, allowing lower documents enough time and space to adjust to hierarchically senior documents" (Piatkowski et al. 2014: p. 35). In addition, the report found that in order to avoid duplication and to maximize synergies, national level leadership should be strengthened by adopting a more active coordinating role, providing enhanced procedural support to regional governments, and mapping out potential industrial specializations throughout the country.

In many cases, regions were unable to design strategies that differentiated themselves from other regions. Their strategies tended to be very generic and lacked a clear link to the region's specific characteristics and endogenous potential. According to Klincewicz (2014: p. 22), "the regions selected similar specializations, related to the most popular, broadly defined technology areas, without major intra-regional differentiation." In some instances, this was due to an attitude of "mechanical fulfillment" of smart specialization strategies. Policy-makers felt that they had adequately complied with EU funding requirements and fell short of constructing tangible regional socio-economic transformation. Moreover, innovation strategies have been aligned with capacities in implementing agencies rather than with firm needs, leading to an excessive focus on public research institution agendas rather than on market demands (Kapil et al. 2014).

To improve national-regional coordination, Poland relied on territorial contracts signed between the central government and the individual regions in 2014. The aim was to define the region's tasks and objectives as well as the mechanisms for disbursement of EU funds allocated to the region for 2014–2020. Importantly, these contracts strive to delineate a clear line of demarcation between the responsibilities of the central and regional governments, and thus set the framework for regional intervention.

Sources: Kapil et al. 2014; Klincewicz 2014; Piatkowski et al. 2014.

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[2] In 2011, the European Commission created the Smart Specialization Platform "to provide information, methodologies, expertise and advice to national and regional policy makers, as well as to promote mutual learning, transnational cooperation and contribute to academic debates around the concept of smart specialization." This was followed by the 2012 publication of the "Guide to Research and Innovation Strategies for Smart Specialization (RIS3)." Both are also useful tools for countries outside the EU and are available at: http://s3platform.jrc.ec.europa.eu/

Beyond industrial targeting, the priority areas can be "activities" (e.g., advanced manufacturing, clean energy, e-health, research labs, design, or headquarter functions) or "key enabling technologies" (e.g., ICT, nanotechnologies, biotechnology, etc.), which cut across several industries. As regions try to determine pathways for smart specialization, it is critical that they connect with the national vision and that they consider the specialization choices of other regions in the country, so as to build synergies and avoid duplications. However, a frequent scenario in many lagging regions is the difficulty in finding clear strengths or market trends in which to determine their most appropriate specializations. Therefore, they often choose a more flexible strategy that encompasses enabling policies for entrepreneurship and market selection, rather than *ex ante* targeting (Correa and Guceri 2014).

Regional innovation strategies should rely on an inclusive consultation process, including representatives of local, regional, and national governments as well as all relevant stakeholders (academia, firms, entrepreneurs, NGOs, etc.). An expert group should assess regional strengths, weaknesses, opportunities, and threats (SWOT), using methodologies, such as production and trade indicators, bibliometric indicators, technology foresight, benchmarking, and independent expert assessments. In addition, regional innovation strategies should provide a stable budgetary framework and optimize all available financial resources, including decentralized funding (i.e., decentralization of allocations in centrally developed programs), autonomous funding (i.e., regional discretionary budget allocation), and regional power of taxation (Cooke et al. 1997).

Policy-makers should ensure that regional innovation strategies translate into measurable goals and plan how specific policy instruments will achieve those goals. Choosing the appropriate policy mix is a complex process that involves selecting a set of different and complementary policy instruments to address the constraints identified in the innovation system. The objective is to unveil and maximize synergies, or positive interactions between policy instruments, while avoiding duplication and negative interactions. However, in practice, policy instruments are often selected based on the continuation of previous schemes or pressure from specific lobbies and interest groups, rather than on visionary considerations of policy mix interactions and critical assessments of the most acute problems (Borras and Edquist 2013). When selecting the innovation policy mix at regional level, it is first necessary to assess: (1) what is being done at the national level, (2) what else is needed, (3) how is it possible to tailor national programs to the regional context, and (4) what opportunities would complement national programs with regional initiatives? Indeed, regional innovation policy does not occur in a vacuum, but rather within the context of a broader national innovation system.

Ultimately, regional innovation strategies should be operable and easily understandable to the public. They should introduce a clear plan of action for implementation, while allowing for flexibility. Drafting a strategy and agreeing on objectives is the easiest part, while the biggest challenge lies in implementation. Policy-makers should be careful to avoid any incongruity between strategy and implementation. For example, in the case that regions design strategies for the sole purpose of securing more funds or that they comply with higher level requirements, but then continue with "business as usual."

3.2 Regional Capacity Building

Many regions in developing countries lack the critical mass and capacity to tackle the costly, risky, and path-dependent nature of innovation. Recently, much of the push for decentralization in developing countries has primarily been on the expenditure side, while local revenue capacity has remained weak (Gadenne and Singhal 2013). This is a source of tension between the national and regional levels of government and requires new systems of funding, as discussed in Section 2.2.2. Beyond funding, lagging regions in developing countries are often characterized by "organizational thinness," that is, by a lack of innovative firms, efficient public agencies, and adequate knowledge infrastructure to support collective learning (Asheim and Isaksen 1997).

Against this background, it is important that the national government support the devolution of competences with measures to build regional capacity. First, central governments can offer regional governments information, technical assistance, and training and advice. Second, the national government can establish mechanisms that identify and share best regional practices. Third, they can foster collaboration among regions, especially where the regions face problems of critical mass or in the case of counter-productive inter-regional competition. In particular, the central government can encourage collaboration by providing incentives to joint regional initiatives. For example, in Mexico, the National Science and Technology Council launched the program FORDECYT to provide funds to groups of states that face common thematic challenges or a functional geographic need (OECD 2009b). During Poland's accession to the European Union, the government formed a macro-region called Eastern Poland, bringing together the five poorest regions of the country in order to secure additional European funding. However, despite the common challenges facing these regions, they could not agree on a common innovation strategy, so the government abandoned the program in 2014 (Piatkowski et al. 2014).

3.3 Using Regional Innovation Policy to Close Income Gaps and Address Societal Challenges

Innovation policy in developing countries should align more closely with the broader development agenda for fulfilling the basic needs of citizens, given that a large share of the population faces acute shortages of food, water or electricity, as well as inadequate education and healthcare. If properly managed, decentralization of innovation policy can contribute to this agenda, fostering bottom-up, participatory approaches that promote social innovation (Mercado 2012).

As discussed in Section 2.1, national governments often attempt to use regional innovation policy to reduce income disparities across regions because of the direct link between innovation and economic convergence/divergence. However, as examples from Mexico, Russia, China and Colombia show, this is a challenging task. One challenge is an equity/efficiency dilemma, in which concentrating public resources in the most advanced regions helps to build critical mass and larger outputs (in terms of aggregate innovation performance and economic growth) than would concentrating public support in underdeveloped regions. A second challenge is what Oughton et al. (2002: 27) call the "regional innovation paradox," which refers to the contradiction between the comparatively greater need to spend resources on innovation in lagging regions and their relatively lower capacity, as compared to more advanced regions, to absorb public funds. The Mexican mixed funds and the Colombian royalties fund cases demonstrate this effect. Third, innovative actors from the periphery to the core are often blocked from beneficial agglomeration effects found in more advanced regions (McCann and Ortega-Argiles 2014). For example, lagging regions' investments in advanced training and support for entrepreneurs could potentially move toward core regions.

Addressing these challenges requires policies that increase regional capacity to absorb innovation-related funds and closer interactions between government, industry and universities (Oughton et al. 2002). In order to avoid the risk of regional fund migration to core regions, investments should focus on regional strengths and local industrial needs, and they should be directed, wherever possible, toward "local fixed assets" (e.g., a local center of competence, a local university research program to address the needs of a regional cluster, etc.). Another line of action is to encourage core regions to orient their research agendas toward the needs of peripheral regions.

Collaboration between regions can build strong absorptive capacity in lagging regions and reorient leading region agendas toward larger development challenges (e.g., health, hunger, education, rural development, etc.). However, policy-makers should carefully address barriers to cross-regional collaboration,

such as political pressure facing regional policy makers to properly capture regional investment benefits, as in the case of Colombia's new royalties fund (Box 3).

3.4 Monitoring, evaluation and experimentation

Monitoring and evaluation systems should formulate precise objectives, identify relevant indicators, set realistic targets, and devise appropriate incentive mechanisms. Indicator systems should help inform both short-term decisions and long-term strategies. However, it is very difficult, in practice, to identify cause and effect relationships between regional policy and innovation outputs. Beyond the general difficulties associated with the intangible and long-term nature of the returns of R&D and innovation, the effects of regional programs are often intertwined with those of national programs, such that it is difficult to attribute outcomes to a particular level of intervention.

In any case, the central government should monitor regional performance within nationally funded programs to ensure that the agreed upon objectives are met. Moreover, the central government's monitoring and evaluation practices allow for regional comparisons, standardize evaluation methods, and serve as a platform for sharing experiences across regions. Indeed, evaluations should aim to identify successful regional programs and replicate them in other regions. However, the monitoring and evaluation system also needs to include the bottom-up dimension. For example, the central government should establish mechanisms to incorporate feedback from the regions to improve national policies. Central governments can also act as focal points for collecting, evaluating, and disseminating international experience.

Policy evaluation should also determine whether regional innovation strategies are addressing potential strategy-implementation incongruities (see section 3.1). Regional innovation strategies should provide a certain degree of continuity as a sign of commitment to firms and other organizations, which make innovative decisions in the context of policy. Moreover, because the returns on R&D and innovation often appear only after sustained, long-term investments, they require a long-term policy vision. Despite the need for stability, the policy mix also needs to adapt to new challenges and opportunities. Thus, program monitoring and evaluation should strive for a balance between stability and experimentation, allowing sufficient flexibility for the redesign of programs during their life cycles, according to changing conditions, interim assessments, and user feedback.

4. CONCLUDING REMARKS

Despite the trend toward decentralization, an excessive enthusiasm toward the devolution of competences to developing country regional governments would be risky. National governments should take a strong role in innovation policy by building institutional frameworks, defining national strategies, seeking coherence and economies of scale, and avoiding wasteful duplication across regions. Yet, greater regional involvement in innovation policy requires central governments to shift from omnipresent control to facilitation, capacity building and support. Policymakers should continue to reflect on how to better approach the challenges of multilevel governance. This paper has offered an overview of different policy options and presented a review of recent international experiences, with the hope of fostering better-informed policy experimentation in developing countries. However, we still lack sufficient data on the correlation of policies and outcomes both because the examples we have reported here are still very young, and because of the inherent difficulty in measuring policy outcomes and institutional changes.

Finally, we would like to stress that a "one-size-fits-all" approach to regional innovation policy is inappropriate (Holbrook and Salazar 2004; Todtling and Trippl 2005). Instead, a "*flexible, decentralized policy process that takes the diversity of circumstances into account is needed*" (World Bank 2010: 253). Regions are significantly different from each other, each with its own technological trajectories, institutional settings, governance abilities, and industrial strengths and

weaknesses. And, this warrants a differentiated approach. Innovation policies and knowledge hubs in high-technology regions are necessarily different from those that would be appropriate for industrial production zones or yet from those that could facilitate a resurgence of science and technology in underdeveloped regions. From the perspective of the central government, this calls for a flexible and asymmetric approach to decentralization across regions that takes into account each region's unique technological endowments, administrative capacities, and political wills.

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