

IMPLEMENTING INNOVATION POLICIES

CAPABILITIES OF NATIONAL DEVELOPMENT BANKS FOR INNOVATION FINANCING

Marco Carreras
Stephany Griffith-Jones
José Antonio Ocampo
Jiajun Xu
Anne Henow



**Cataloging-in-Publication data provided by the
Inter-American Development Bank
Felipe Herrera Library**

Implementing innovation policies: capabilities of national development banks for innovation financing / Marco Carreras, Stephany Griffith-Jones, José Antonio Ocampo, Jiajun Xu, Anne Henow.

p. cm. — (IDB Monograph ; 1035)

Includes bibliographic references.

1. Development banks-Effect of technological innovations on-Latin America. 2. Financial institutions-Effect of technological innovations on. 3. Technological innovations-Latin America-Finance. I. Carreras, Marco. II. Griffith-Jones, Stephany. III. Ocampo, José Antonio. IV. Xu, Jiajun. V. Henow, Anne. VI. Inter-American Development Bank. Competitiveness, Technology and Innovation Division. VII. Series.

IDB-MG-1035

JEL Codes: O2, O16, O23, O31, O38

Keywords: innovation, national development banks, public financial resources.

Inter-American Development Bank
1300 New York Avenue, N.W.
Washington, D.C. 20577
www.iadb.org

Copyright © 2022 Inter-American Development Bank. This work is licensed under a Creative Commons IGO 3.0 Attribution-NonCommercial-NoDerivatives (CC-IGO BY-NC-ND 3.0 IGO) license (<http://creativecommons.org/licenses/by-nc-nd/3.0/igo/legalcode>) and may be reproduced with attribution to the IDB and for any non-commercial purpose. No derivative work is allowed.

Any dispute related to the use of the works of the IDB that cannot be settled amicably shall be submitted to arbitration pursuant to the UNCITRAL rules. The use of the IDB's name for any purpose other than for attribution, and the use of the IDB's logo shall be subject to a separate written license agreement between the IDB and the user and is not authorized as part of this CC-IGO license.

Note that the link provided above includes additional terms and conditions of the license

The opinions expressed in this publication are those of the authors and do not necessarily reflect the views of the Inter-American Development Bank, its Board of Directors, or the countries they represent.



The Institutions for Development Sector was responsible for the production of this publication.

Coordination: Vanderleia Radaelli (Competitiveness, Technology and Innovation Division - Institutions for Development Sector, IDB)

Collaboration:

Eduardo Fernández-Arias (International Consultant, Specialist in Economic Development)

Gustavo Crespi (Competitiveness, Technology and Innovation Division - Institutions for Development Sector, IDB)

Nathália Amarante Pufal (Competitiveness, Technology and Innovation Division - Institutions for Development Sector, IDB)

EXTERNAL VENDORS

Production Editor: Sarah Schineller (A&S Information Partners, LLC)

Editors: Leslie Hunter and Amy Scott (Nomad Editorial)

Design: Jesús Rivero (Beyup Global)

IMPLEMENTING INNOVATION POLICIES

CAPABILITIES OF NATIONAL DEVELOPMENT BANKS FOR INNOVATION FINANCING

Marco Carreras
Stephany Griffith-Jones
José Antonio Ocampo
Jiajun Xu
Anne Henow



Contents

Introduction	6
1 Analytical Framework	10
The Development Mission of the State: The Role of Industrial Policy	11
Systems of Innovation, Financial Support, and the Importance of Adapting to Countries' Developmental Stages	16
Market Failures Impeding the Private Financing of Socially Efficient Innovation Projects	19
The Role of National Development Banks in Supporting Innovation and Its Adaptation over Time	21
1.1 Key Capabilities Required to Identify, Implement, and Evaluate Programs to Support Innovation Investments	30
1.2 Comparative Advantage of Development Banks Compared with Other State Interventions	31
2 Methodology and Data Collection	33
Findings: Comparing Capabilities to Support Innovation Activities across National Development Banks	35
2.1 Interaction with Other Actors in the Design of Public Policies and Activity of Development Banks	37
2.2 Innovation Portfolio of National Development Banks	38
2.3 Learning Mechanisms to Identify Impediments to Innovation	43
Evaluations and Periodic Reviews by Independent Evaluators	43
Formal Links with the System of Science and Technology	44
Dialogue between National and Local Stakeholders	46
Building Up Internal Capacity on Catching Up	48
Learning to Learn or Learning-by-Doing	49
Specialized Units	50



2.4 Design and Implementation Strategies of National Development Banks for Innovation Financing	52
2.5 Institutional Capabilities of National Development Banks	53
2.6 Self-Evaluation of the Activities in Support of Innovation	54
Conclusions and Policy Recommendations	55
References	58
Appendix	69
A1 Systems of Innovation	70
A2 Letter for Interviews	72
A3 Interview Questions	74
A4 Summary of the Interviews: Comparing Capabilities to Support Innovation Activities across National Development Banks	76
A4.1 National Development Banks' Innovation Mandate	76
A4.2 Interaction with Other Actors in the Design of Public Policies and Activities of Development Banks	80
A4.3 Innovation Portfolio of National Development Banks	84
A4.4 Learning Mechanisms to Identify Impediments to Innovation	88
A4.5 National Development Banks' Design and Implementation of Strategies for Innovation Financing	91
A4.6 Institutional Capabilities of National Development Banks	94
A4.7 Self-Evaluation of Activities in Support of Innovation	97



Introduction



The role of the state as the leader in setting industrial policies and providing support for innovation activities has been widely recognized not only for developing countries (Chang, 2002; Rodrik, 2004) but also increasingly for developed countries (Mazzucato, 2011; Block and Keller, 2015). This is even more the case since the beginning of the COVID-19 pandemic. At the same time, the discussion on the importance of credit creation and risk-taking capital markets for the dynamics of innovation, to support entrepreneurs raising their investment levels, has deep historical roots (Schumpeter, 1934; 1939), and it has regularly been at the center of academic and policy debate (Rodrik, 2004). Industrial policies, particularly when targeting high-risk activities, require a large and constant flow of financial resources for a lengthy period of time. While they have high potential for social and developmental impact, investments in innovation are often characterized by high risk, uncertainty about success and appropriability, long duration, and young age of the borrower (usually a start-up firm). All of these factors discourage both firms' decision to invest (Crespi, Fernández-Arias, and Stein, 2014a) and adequate allocation of financial resources from the private financial sector (Griffith-Jones et al., 2020).

The central role historically played by banks in supporting technological change, human capital, and research and development (R&D) has changed over the years, from a long-term relationship with entrepreneurs based on trust (Minsky, 1981) to an impersonal relationship between agents and customers, mediated by credit ratings (Kregel, 2008). The recent greater financialization of bank operations, due to the higher profitability of the financial sector compared to the nonfinancial sector (Block, 2014; Kay, 2012; Wray, 2011), eventually led to a situation in which the financial sector ended up financing itself, becoming increasingly detached from the real sector (Haldane and Davies, 2011; Mazzucato and Wray, 2014; Minsky, 1981; Wray and Tymoigne, 2008). Rising concerns about the difficulty of capturing the returns from successful investments that are not fully internalized but partially disseminated throughout the economy, the long timeframes necessary for innovation to take place, and the uncertainty embedded in these processes mean that profit-maximizing commercial banks are not always able to supply sufficient financing, due to their greater focus on the maximization of their risk-adjusted expected short-term returns. Projects have a high failure rate, and regulatory frameworks are not always appropriate depending on the degree of novelty of the innovation (Griffith-Jones et al., 2020; Rodrik, 2004).

Capital markets, on the contrary, are often seen as institutions that are well positioned to finance high-risk innovation projects, although they are becoming increasingly more focused on short-term returns (Davies et al., 2014; Haldane, 2015; Kay, 2012). Evidence from public sources has shown that, contrary to the general belief, in countries like Finland, Israel, and



the United States, capital markets have not played a major role in providing early-stage financing for highly innovative investments (Breznitz and Ornston, 2013; Keller and Block, 2013; Whitford and Schrank, 2011). At the same time, it has been recently observed that in some regions, including Latin America, capital markets have been reinforcing and expanding their position since 2018, reaching record levels over the first half of 2021. This has contributed to a dramatic expansion in the number of unicorns in Latin America and the Caribbean from 2 to 34 in the last four years.¹

The importance of long-term financing and high risk tolerance as central tools for innovation (Christensen, 1992; Freeman, 1987; Lundvall, 1992) has given rise to financial institutions with the capacity to supply this type of capital. In this regard, the Keynesian view that financial markets are not fully developed is one of the key justifications for the creation and existence of national development banks (NDBs). Like other public institutions, NDBs have different risk-return considerations compared to private commercial banks. Among their most important roles is providing financial support to development by helping finance high-priority areas that the private sector perceives as too risky to invest in on its own (Griffith-Jones and Ocampo, 2016). In this context, the selection of the areas of intervention is crucial, as the potential for spillovers is directly related to the type of investment supported (Crespi et al., 2020). To correctly address market failures, it is necessary not only to provide sufficient financing, but also to use the appropriate financial instruments. Different instruments serve different purposes according to the nature of the borrower, the type of investment, and especially the type of market failure (Fernández-Arias and Xu, 2020). The types of financial instruments offered strongly depend on the type of financing that NDBs can raise. They must be designed to serve specific purposes, and they must be adapted to the challenges at different stages of development (Lin, Sun, and Jiang, 2013).

How NDBs should use their resources to encourage positive economic risk-taking while minimizing financial risk is of fundamental importance in this context (Griffith-Jones et al., 2020). At the same time, given the limited availability of resources, it is also important to guarantee that NDBs generate additionality by crowding in additional resources to the economy. The kinds of capabilities that NDBs need to acquire, develop internally, or integrate to successfully support the financing of worthy innovative projects can be divided into three groups (Cornick et al., 2018; Crespi, Fernández-Arias, and Stein, 2014b): (i) technical (financial as well as technological); (ii) operational, to implement programs in coordination with clients and

1. <https://labsnews.com/en/articles/business/latin-america-has-a-record-of-over-6-billion-in-investments-for-startups-in-a-half-year/>



partners; and (iii) public governance, to ensure political support for preserving functional independence to avoid capture. Although all crucial, the capabilities that each type of market failure requires may vary. The ability of NDBs to adapt their strategies and apply solutions to specific contexts is fundamental.

The recent challenges of the COVID-19 pandemic shone an even brighter spotlight on the types of dynamic knowledge and competencies needed within NDBs to quickly adapt to different contexts (Mazzucato and Kattel, 2020). The correct balance is needed to maintain and support a long-term vision while addressing the short-term economic and social consequences of a crisis. So far, NDBs and multilateral development banks (MDBs) appear to have quickly reacted and supported national economies in most countries (McDonald, Marois, and Barrowclough, 2020), building on the experience of the 2008 economic crisis without apparently compromising their long-term missions such as promoting the green economy and innovation (Carreras and Griffith-Jones, 2020).

This comparative note builds on the primary data collected through flexible semi-structured interviews with current or former NDB officials, validated and supplemented by interviews with stakeholders outside the NDB. It describes common and different practices around the subject of capabilities of the selected NDBs. The analysis will study the strategies followed by the NDBs for the design and implementation of innovation support programs and the capacities they need to be successful. Little is known about the experience of those NDBs in the world that have been most successful in designing and implementing programs to support innovation. This work describes all the dimensions of NDBs' internal organization to carry out this activity. Key questions of the analysis are: (i) What priority do NDBs assign to the financing of innovation projects?; (ii) Which operating models would be most effective in financing high-potential innovation projects, avoiding capture? Should they operate on the first and/or second tier?; (iii) What capabilities—(a) governance, (b) technical (financial and technological), and (c) operational (implementation and sustainability)—should NDBs develop to support innovation credit?; (iv) How, based on their contact with clients, can NDBs help identify market failures faced by innovative companies and thus produce and organize information on potential projects with high social returns?; and (v) What is the best framework for coordinating the work of the NDBs with the innovation agencies?



1

Analytical Framework



The Development Mission of the State: The Role of Industrial Policy

The central and interrelated challenges of industrial policy are the promotion of structural change in the economy and of the innovations and technical change that lie at the center of that process. The concept that economic growth is always associated with innovation and the change in the economic structure has its roots in Schumpeter (1939) and has been emphasized more recently by the neo-Schumpeterian and evolutionary schools (Freeman and Soete, 1997; Pérez, 2002). The association of growth with structural change is also at the center of the work of Chenery, Robinson, and Syrquin (1986) and of a broader set of schools of economic thought.² We can add the growth-productivity connections emphasized by Kaldor (1978), and those of increasing returns underscored by contemporary neoclassical models of economic growth.³

This implies that the support for innovation and new economic activities must be at the center of an appropriate development strategy. Its major policy focus should be dynamic efficiency, understood as the capacity to generate new waves of structural change (Ocampo, 2017; 2020). What this means is that the focus in emerging and developing countries should be to promote new dynamic economic activities, the learning processes associated with technological catch-up, and the capacity to gradually join the world of innovators. The creation of the domestic linkages or “value chains” associated with innovative sectors must also be part of that strategy, as well as the adequate management of natural resources in countries that have a strong static comparative advantage in commodity production. It equally involves the reduction of the heterogeneity of production structures, due to the coexistence of low- (informal) and high-productivity activities, as emphasized by Lewis (1954) and Ros (2001), among others.

Contextual conditions include an adequate education system, a proper physical infrastructure, a nondiscretionary legal system, an impartial and efficient state bureaucracy, and smooth business-labor-government relations. Avoiding macroeconomic instability is equally essential, particularly guaranteeing competitive and stable real exchange rates in the face of

2. See, among an extensive literature, Nelson and Winter (1982), Dosi et al. (1988), Taylor (1991), Chang (1994), Nelson (1993; 1996), Aghion and Howitt (1998), Rodrik (1999; 2007), Ros (2001; 2013), Amsden (2001), Ocampo, Rada, and Taylor (2009), Lin (2012), Stiglitz and Greenwald (2014), and Cherif and Hasanov (2019).

3. See the now-classic contributions by Romer (1986), Lucas (1988), and Barro and Sala-i-Martin (2003).



terms-of-trade fluctuations and capital account volatility.⁴ However, we will leave these issues aside, to concentrate on the institutions and policies that relate to structural change.

The role of industrial policy in these processes has been the subject of heated controversies. In recent decades, the emphasis has been on the positive role of trade openness, but there is no simple relationship between trade liberalization and growth, as underscored in a seminal paper by Rodríguez and Rodrik (2001). Indeed, to the extent that economies of scale and learning play an important role in international specialization,⁵ comparative advantages can be created. More broadly, successful development experiences have been associated with variable policy packages (Diao, McMillan, and Rodrik, 2019; Helleiner, 1994; Rodrik, 2007). Industrialization and manufacturing export growth have been crucial elements of East Asian success stories, and later of those in Southeast and some South Asian countries, but have involved significant elements of state intervention. In contrast, in recent decades some regions in the developing world—particularly Latin America—have been facing a “premature deindustrialization” (Dasgupta and Singh, 2006; Palma, 2005; Rodrik, 2016).

The dynamics of production structures can be seen as the interaction between two basic forces: (i) innovations—broadly defined as new technologies, new activities, and new ways of doing previous activities—and the associated learning processes; and (ii) the intra- and inter-sectoral linkages and, more broadly, the value chains created around innovative sectors (Ocampo, 2017; 2020). The institutions required to support these processes are crucial, and also subject to learning. Elastic factor supplies of quality labor are essential, as well as adequate financing facilities—the focus of this report. Dynamic microeconomic changes are the building blocks, but the development of competitiveness is a system-wide feature (Fajnzylber, 1990).

This definition of innovations follows the broad concept of “new combinations” suggested by Schumpeter (1961): new qualities of goods and services, new production methods or marketing strategies, opening of new markets, new sources of raw materials, and new industrial structures. Today we would also add new ways of managing the environment, notably adapting to and mitigating climate change. The definition includes technological innovations—the more common use of the concept of innovations in the economic literature—but also a broader set of economic processes.

4. See in this regard Rodrik (2008) and Missio et al. (2015).

5. See Krugman (1990) and Grossman and Helpman (1991) and, in relation to developing countries, Ocampo (1986).



In developed countries, the incentive to innovate is provided by the extraordinary profits that can be earned by the pioneering firms that introduce technical, commercial, or organizational changes, or that open new markets or find new sources of raw materials. This incentive is necessary to offset the uncertainties and risks involved in the innovators' decisions, the incomplete nature of their initial knowledge, and the fact that, due to the externalities that the innovation generates, they may not be able to fully appropriate its benefits. Innovations, therefore, have a mixture of attributes of private and public goods. State financing of research and development and the protection of intellectual property rights, as well as different ways of financing—notably private equity funds—are essential elements to generate the necessary financing and incentives to innovate.

In developing countries, innovations are largely associated with the windows of opportunity that come with transfer of sectors, new products, technologies, and organizational or commercial strategies previously developed in industrial centers (Pérez, 2001). The benefits to firms will depend on the mix between the benefits of lower production costs vs. the thinner profit margins of mature activities and the costs of accessing the appropriate technologies. The net benefits may be limited; thus, in the absence of policy incentives, there may be a suboptimal search for new economic activities (Hausmann and Rodrik, 2003).

No innovative process is passive, as it requires investment and learning. Technological expertise must also go through a maturation process that is linked to the production experience. A more ambitious policy aimed at climbing up the ladder in the world hierarchy requires shortening transfer periods and, most importantly, gradually becoming a more active participant in technology generation (Lee, 2019). In the case of agriculture, innovations must be adapted to ecosystems, a process that normally takes time (as it must deal with biological cycles) and therefore local research. In all cases, national innovation systems must be built, including institutional frameworks to coordinate the various actors engaged in innovation and learning. These include research and development centers, universities, technological schools, extension services, financing actors, and the innovating firms themselves. An ambitious educational strategy should support this process.



“Evolutionary” theories of technical change provide essential insights into learning dynamics.⁶ These theories emphasize the fact that technology is largely tacit in nature—that is, that detailed blueprints cannot be plotted. This means that technology is incompletely available and imperfectly tradable, as it is largely composed of intangible human and organizational capital. This implies that technological proficiency has a strong learning-by-doing component, and that firms that purchase technology must invest in mastering it, a process that involves adaptation and even redesigns and other secondary innovations. An additional implication is that innovative firms only imperfectly appropriate their benefits. This is particularly critical for innovations that cannot be patented (e.g., the development of new activities or new marketing strategies).

Linkages and related value chains are associated with the development of networks of suppliers of goods and specialized services, marketing channels, and organizations and institutions that disseminate information and coordinate the relevant agents. This concept summarizes the role played by backward and forward linkages (Hirschman, 1958), but also that of (private or public) institutions that are created to reduce the cost of information (e.g., on technology and markets) and to mitigate the coordination failures inherent in interdependent investment decisions (Chang, 1994). Complementarities generate positive externalities among agents, which help reduce their costs. They are one of the bases of the economies of scale that determine the competitiveness of production sectors in a given region or country—or the lack of it.

The cost and quality of nontradable inputs are particularly important in this regard. They contain specialized services, including knowledge, and logistical and marketing services, for which proximity to producers who use the inputs or services may be a critical factor. They may also include specialized financial services, where closeness can also be important due to asymmetric information. In turn, the capacity to generate value chains in which exports have a higher domestic value-added determines how much a given country benefits from trade.⁷

The capacity of innovative activities to attract capital and labor will be a critical factor in facilitating the growth of these activities. One factor is the role of national development

6. See Nelson and Winter (1982), Nelson (1996), and Dosi et al. (1988) and, with respect to developing countries, Katz (1987), Lall (1990), and Lee (2019). Similar concepts have been developed in some versions of the new neoclassical growth theory, in which “knowledge capital” is a form of “human capital” with three specific attributes: it is “embodied” in particular persons, it is capable of generating significant externalities, and it is costly to acquire (Lucas, 1988).

7. Such contents differ considerably among countries. See in this regard the OECD’s Trade in Value Added Database at <https://www.oecd.org/sti/ind/measuring-trade-in-value-added.htm#access>.



banks (NDBs) in facilitating long-term finance and other ways of supporting innovative activities. International capital mobility—particularly foreign direct investment—can also play an important role. International labor migration may be critical for skilled labor. Unemployed or, more typically, underemployed natural resources can facilitate the expansion of innovative sectors and, in the developing world, underemployment (or informality) can generate an additional supply of the labor required by a surge of economic growth.

The interplay between these factors will determine the dynamic efficiency of a given process of structural transformation. Innovations accompanied by strong linkages will result in a virtuous circle of high investment, accelerated technological learning, and institutional development. The East Asian success stories are an excellent example. The opposite case is characterized by the weakness of both learning and complementarities. A classic case is natural resource enclaves and, more recently, the premature deindustrialization processes.

The appropriate industrial policy to guarantee these results should mix horizontal with selective policies. Although a fundamental advantage of horizontal policies is their neutrality vis-à-vis individual agents, selective policies must be part of an effective structural diversification strategy that reinforces successful specialization patterns, helps nurture “infant sectors,” and creates dynamic comparative advantages. This requires overcoming the market failures associated with public goods attributes of technological development and the coordination failures associated with the development of new sectors. It also requires overcoming “market gaps” (nonexistent markets) and involves the creation of markets and production sectors, as Mazzucato (2011) has emphasized. These policies must include support for research and development in the relevant sectors, and for the institutions that help coordinate investments by firms in those sectors, their export strategies, and special long-term credit lines from NDBs. Furthermore, when there are limited resources, any horizontal policy must be detailed, and hence necessarily becomes selective. Examples are the allocation of resources from funds for technological development and export promotion. Recognizing the implicit selectivity in horizontal policies will lead to a better allocation of resources.

Under current global conditions, emphasis should be placed on integrating into dynamic global markets and thus on developing competitive export sectors. Incentives should be granted based on performance, generating “reciprocal control mechanisms,” to borrow Amsden’s (2001) term. In this regard, the capacity to export is indeed the best control mechanism, as the East Asian success stories indicate. The institutional structure that guarantees this should be subject to periodic evaluations within its learning path.



Structural transformation is not a one-off process; it is continuous, and it may face obstacles at any stage. Furthermore, the process is by no means smooth: destruction is a constant companion of creation,⁸ and dualism is a persistent feature that may increase at different stages. In this context, it is critical to support the restructuring of firms in old sectors and regions where they are concentrated, avoiding transformation processes that increase dualism and working to upgrade low-productivity activities, notably in small firms.

Finally, the relationship between structural dynamics and long-term growth generates a dual link between economic growth and productivity. The first link goes from productivity to growth. First, technical change directly increases aggregate supply; this is the channel most emphasized in the growth literature. It also generates new investment that increases aggregate demand—a Keynesian link. If the economy is constrained by foreign exchange—a situation not uncommon in developing countries (Thirlwall, 2011)—technical change also improves international competitiveness and weakens that constraint. On the other hand, economic growth has positive effects on productivity through four channels: (i) dynamic economies of scale of a microeconomic character, associated also with learning and induced innovations; (ii) technology embodied in new equipment; (iii) the productivity effects of the development of complementarities (production and technology externalities); and (iv) the transfer of underemployed workers to higher-productivity activities (Kaldor, 1978; Ocampo and Taylor, 1998; Ocampo, Rada, and Taylor, 2009).

Industrial policy can increase productivity and growth through these links. A crucial element is financing, an area in which development banks (DBs) can play a leading role. Financing must, of course, mix in interaction with other pillars of industrial policy, notably investments in science and technology, but also export promotion and other forms of innovation, including climate change mitigation.

Systems of Innovation, Financial Support, and the Importance of Adapting to Countries' Developmental Stages

In a Schumpeterian approach, economic development is the outcome of endogenous and discontinuous changes in the economy, leading not only to improvements in production techniques and products, but also to the creation of new markets (Schumpeter, 1934; 1942). While

8. "Creative destruction," to use Schumpeter's (1962) terminology, or Easterly's (2001) complementary and substitution effects.



the importance of innovation was already at the center of the academic and political debate, the necessity of using a systemic approach to study the drivers of innovation and economic development emerged in the 1980s. The crucial aspect in the systems of innovation approach framework is related to the definition of innovation. Over the years, scholars have provided different definitions of innovation, from a narrow definition that focuses on the introduction of radical or incremental novelties in the market, to a broad definition that encompasses the diffusion, absorption, and use of innovation (Lundvall, 2007). Nevertheless, a common element of all definitions of innovation is the importance of aggregation and interactions between different public institutions and private actors, as well as other factors influencing the generation and diffusion of knowledge and innovation capabilities. With respect to systems of innovation, there are at least three approaches widely recognized by the academic literature: national, local/regional, and technological/sectoral. All are interrelated and are not mutually exclusive (Chang and Chen, 2004). For a detailed description of different types of systems of innovation, please refer to Section A1 in the Appendix.

Despite the focus on the national, regional, or sectoral/technological level, countries' institutional, industrial, and financial structures strongly depend on their factor endowment and on the developmental stage of their economies and societies. In addition, the risks faced by the companies are heterogeneous across industries and depend on countries' technological and developmental stage (Lin, Sun, and Jiang, 2013). They can be grouped into three categories, namely technological innovation, product innovation, and entrepreneurship risks. At national level, the types of innovation and the type of associated risks strictly depend on countries' stage of development. At the early stage, economies enjoy the latecomer's advantage by imitating foreign mature technology and adapting it to local contexts. Adaptation of existing technology to local conditions requires special support. It is also essential to promote new innovative activities in traditional sectors and to support innovative activities that involve catching up and even becoming leaders in the new activities. By contrast, at the advanced stage of development, innovation means pushing the technological frontier with big uncertainties.

Countries in early stages of development are characterized by an abundance of cheap labor and scarcity of capital. The opposite is true in countries at more advanced developmental stages, where capital-intensive industries replace more labor-intensive sectors. Consequently, the different factor endowments in countries at earlier and later stages of development have implications not only for the types of industries but also on the size of the companies and the types of activities performed. By contrast, capital-intensive industries in more developed economies must invest in R&D activities to improve their technology, thus increasing the technological innovation risk.



Consequently, financial sectors must constantly adapt to meet the needs of the different sectors depending on their technological and developmental stage. At the initial stages of development, small and labor-intensive companies relying on technologies already developed require fewer financial resources, and the risks faced by financial institutions are related more to the lack of information about companies' and managers' abilities (entrepreneurship risk) than to the technological characteristics of the investments (technological risk) or the novelty of the product in the market (product risk). Hence, the lack of information about the borrowers in countries at their earlier stages of development highlights the need for more knowledge-intensive than capital-intensive financial institutions (Lin, Sun, and Jiang, 2013). Typically, the commercial financial sector at this stage consists of several small local banks that can gather better information on the borrowers and on the local market dynamics, due to the higher reliance on soft information compared to large banks (Stein, 2002), but still remain with a limited range due to the low level of capital. This was the case in England until the 1920s (Collins, 1988). Hence, the small size of commercial banks and the low availability of alternative capital markets in developing economies historically meant that the public sector was the only available source of financing for large, high-risk challenges. However, even in countries that lag behind the technological productivity frontier, there might be sectors or even firms that are closer to the frontier (examples are zero tillage machinery in Argentina, ethanol production in Brazil, and the global supplier of Tesla's windshields in Lima, Peru).

As countries move up the ladder, companies' higher demand for capital and greater technological development require that the financial sector adapt to new challenges faced by the industry, which is facing higher product and technological risks. Larger companies that are now operating closer to the technological frontier also require financial institutions that can raise and disburse sufficient resources. In this context, the commercial financial sector is likely to be dominated by large banks, able to face the competition of international markets and to diversify the higher embedded risk involved in investments in innovation. At this stage, alternative financial markets are also quite deep, allowing for diversification of lending sources for companies. At the same time, the higher profitability of the financial sector compared to the nonfinancial sector in more developed economies tends to drain resources from the industry and out of the real economy (Wray, 2011). This lower number of financial resources provided from the private financial sector to the real sector in developed economies must necessarily be compensated by alternative financial institutions, such as NDBs.

Further, in recent decades there has been a shift in the way that commercial banks approach clients, away from a long-term relationship based on mutual trust to an impersonal relationship in which commercial banks end up selling (and sometimes reselling, as in the 2008 sub-



prime mortgage crisis) loans as assets (Minsky, 1981; Wray and Tymoigne, 2008). The combination of the increasing short-termism of the commercial banking sector and the higher profitability of investments in the financial sector relative to those in the real economy calls for financial institutions able to supply the capital required for long-term, path-breaking, and high-risk investments. This short-term nature of the sector contributed to the recent increase in companies' share buybacks in more advanced economies (Lazonick and Mazzucato, 2013). Development banks had successfully undertaken this role, even in many advanced economies, because their nature and mandates call for actions that go beyond risk-reward considerations (still without ignoring them), focusing more broadly on the developmental impact. In this regard, regardless of the developmental stage of the country, DBs have always had a reason to play an active role in the economy related to the difference between maximizing private profits (corrected by private risks) and maximizing social profits (corrected by social risks). Consequently, as for some projects there will always be a gap between net private and net social returns, this implies that private financial institutions will not fund projects that are good from a social point of view but not from the private point of view, leaving the space open for DBs to intervene.

Market Failures Impeding the Private Financing of Socially Efficient Innovation Projects

In academic and political debates, despite the different and polarized views on the necessity of public financial resources to foster investments, there is broad agreement about the difficulty of funding R&D and innovation activities, which have remarkable peculiarities compared to other types of investments (Hall and Lerner, 2010). Low appropriability of the returns, high investments in human capital, and high levels of uncertainty and risk tend to dissuade a risk-averse commercial banking sector. In these cases, and when the adverse side effects of public intervention are less harmful than the market failure itself, the market failure theory (MFT) allows for a public intervention in the economy to cover for the underinvestment of both companies and banks.

Initially introduced in the 1950s following the debate on the Pareto efficient allocation of goods and services in the free market (Arrow, 1951), the MFT framework became increasingly popular toward the end of the twentieth century. More market-centric views have emerged since then. Without neglecting the importance of the public financial sector, the MFT framework limited its intervention to cases of coordination failures, as with the procyclical behav-



ior of private agents, which justified a countercyclical role for the public sector. Other roles reserved for the public financial sector were financing nonexcludable and nonrival projects with low appropriability of returns to address negative externalities, and competition and information failures (Mazzucato and Penna, 2016).

The limitations of the MFT framework in relation to high-risk, high-social return investments (such as R&D activities and innovation), together with the need for a more dynamic and systemic approach, have long been understood (Bleda and Del Rio, 2013; Freeman, 1995; Mazzucato and Penna, 2016). The need for a mission-oriented approach showing directionality represents a market-creating vision complementary to the traditional market-fixing view of the MFT framework, and not the alternative. In this context, recent history shows that infant industries in what are now developed countries were born thanks to a market-creating approach, and not through a neoclassical laissez-faire approach (Chang, 2003).

Broadly speaking, market failures are defined as any situation preventing the private sector from investing in projects with high social value due to their lack of commercial profitability, hence requiring DBs to provide financial resources at below-market cost (Fernández-Arias and Xu, 2020). Despite the complementary market-fixing vs. market-creating views, it is certainly true that the main and distinctive characteristics of investments in innovation often lead to the following situations of market failures:

- Knowledge spillovers or externalities: The low appropriability of innovation outcomes and the presence of nonmarketable externalities—positive ones such as those from basic research and education, or negative, such as pollution and climate change—limits private returns and lowers the profitability of investments in innovation, making them less viable.
- Financial market failure: Investments in R&D are usually characterized by a high share of resources invested in human capital (i.e., intangible assets), and consequently lower relative amounts on physical assets, which represent a more accepted form of collateral by commercial banks. In addition, highly innovative but small companies such as start-ups are usually characterized by a lack of collateral which, in combination with the high risk embedded in innovation investments, drastically reduces the availability of external funders for projects.
- Asymmetric information: Companies usually have access to better information about the likelihood of success of the project compared to external funders, particularly for high-risk investments. This mismatch of information directly and proportionally translates into a re-



duced availability of external funders, which apply a higher premium on their financial services.

- Coordination failures: Investments in R&D require a close alignment of several complementary investments, from human capital to managerial and professional skills, which necessarily implies the presence of the public sector as coordinator.

In the MFT framework, the presence of any of the market failures discussed represents the justification for DBs to provide resources to the market at subsidized rates, hence incurring a financial cost for the state. By identifying the scarcity of long-term capital supplied by the private financial sector for complex investments—which are key for major structural transformation such as the transition to more low-carbon economy innovations—it is then possible to identify the role of NDBs as crucial financial actors in the economy.

The Role of National Development Banks in Supporting Innovation and Its Adaptation over Time

NDBs are development financing institutions that are present in almost all countries, although with different structures and roles that have evolved over time to accommodate countries' specific needs (de Aghion, 1999). Xu, Ren, and Wu (2019), Xu, Marodon, and Ru (2020), and Xu et al. (2021) provide a complete overview of NDBs. While the conditions for their creation depend on country-specific factors, they share some characteristics in all countries, notably: (i) the long-term nature of the development process and its embedded uncertainty and (ii) the difficulty of the private financial sector to evaluate and incorporate risk (Hermann, 2010). NDBs are better at evaluating and incorporating such risks than the private sector, due to their better technical knowledge of projects, among other reasons.

The creation of NDBs also depends on the development stage of the country. While in Europe in the nineteenth century their creation was caused by rapid industrialization (Diamond, 1957; Gerschenkron, 1962), in the twentieth century they were created following World Wars I and II, particularly for the countries that lost in the conflicts. This was the case for the German Kreditanstalt für Wiederaufbau (KfW), founded in 1948 with initial funding provided by the United States through the Marshall Plan, but also for the Export Bank of Japan in 1950 and the Japan Development Bank in 1951. The same can be said for the seven NDBs discussed in this report. In South Korea the end of the Korean War and the need to support national



industries were the reasons behind the establishment of the Korea Development Bank (KDB) in 1954. In Chile, the Corporación de Fomento de la Producción (CORFO), created in 1939 after a major earthquake, is one of the oldest NDBs in Latin America and largely supported Chile's industrial development and public investments. In Mexico, the Nacional Financiera (NAFINSA) was created in 1934 and is the leading development finance institution in Mexico. Its mission is fostering regional and industrial development and the development of a national financial market. In Brazil, the Banco Nacional de Desenvolvimento Econômico e Social (BNDES) was created in 1953 with the mission of supporting national industries. In Colombia, the Instituto de Fomento Industrial (IFI) was created in 1940 to foster industrial development, and Proexpo began in 1967 as a second-tier facility of the central bank to promote nontraditional exports. The latter was transformed into the Banco Colombiano de Comercio Exterior (Bancóldex) in 1991 and absorbed IFI in 2020. In China, the China Development Bank (CDB) was founded in 1994 to support economic and industrial development. In France, the Banque Publique d'Investissement (Bpifrance) was created in 2013 by merging several public agencies, with the aim of organizing and coordinating different forms of public financing to the private sector. The heterogenous evolution of NDBs over time and across the countries, with different specializations and areas of intervention, is an indication of the ability of these institutions to adapt to current and specific national needs at each point in history.

Brazil - Banco Nacional de Desenvolvimento Econômico e Social, BNDES

BNDES was established in 1952 to provide financial resources for the catching-up phase through investments in infrastructure, basic industries, and agriculture. In the 1960s and 1970s, BNDES became one of the leading financial institutions promoting the Brazilian government's import substitution industrialization (ISI) strategies. In the 1980s, the areas of interest included small and medium enterprises (SMEs), energy, agribusiness, and competitive integration. Later, in the 1990s, BNDES supported the process of trade liberalization. Since the election of 2003 and the change in policies, BNDES has become one of the largest mission-oriented DBs. Its countercyclical role was crucial after the 2008 economic downturn. In 2012, it disbursed loans accounting for more than 10 percent of the country's GDP (Ferraz, Além, and Madeira, 2013). More recently, the activity of BNDES declined significantly following changes in governments. However, it remains one of the largest NDBs in the world.



Colombia - Bancóldex

In Colombia, the nontraditional export facility in the central bank, Proexpo, was transformed into an independent bank, Bancóldex, in 1991 and began its operation of financing foreign trade operations in 1992, mainly through second-tier lending. Ten years after it began its operations, Bancóldex absorbed the first Colombian DB, the Instituto de Fomento Industrial (Industrial Development Institute, or IFI). IFI had been established in 1940 with a very different business model, a characteristic that initially created several organizational and operational problems for Bancóldex (Ocampo and Arias, 2018).

Following its absorption of IFI, Bancóldex began its transformation toward a full-fledged DB. Among its priorities were the development and support of small businesses and vulnerable sectors in less-developed regions. Since 2006, Bancóldex has increased support for companies to strengthen their competitiveness and their technological development. After the 2008 crisis, countercyclical lending became one of its primary activities to offset the economic and social consequences of the subprime mortgage crisis. Since 2010, Bancóldex also moved toward financing high-impact regional investment projects, but the main activity in this regard is in the hands of another DB, the Financiera de Desarrollo Territorial (Findeter). The long process of transformation toward a full-fledged DB culminated in 2015 with the definition of a new corporate strategy identifying Bancóldex as the strategic vehicle for entrepreneurial growth in Colombia.

Chile - CORFO

CORFO was created in 1939 and rapidly became a leading financial institution supporting Chilean economic development. Initially acting in support of a national industrialization process in accordance with ISI strategies in place after the Great Depression in the 1930s, CORFO's developmental activity was briefly interrupted during WWII. It started up again as a Chilean DB in support of public companies in various basic industries, such as electricity, steel, oil, telecom, airlines, and others. In subsequent years, CORFO first led the process of nationalization of enterprises followed by privatization of public companies, depending on the policies of the government in power.

During the 1982 debt crisis, CORFO played an important countercyclical role in support of private companies. Following the return of democracy, the bank faced important challenges due to its weak financial position, which improved in subsequent years. CORFO shifted its lending activity toward second-tier operations, later decreasing the disbursement of loans in



favor of grants and guarantees. Since the early 2000s, the focus of its activity has shifted toward SMEs and raising the competitiveness of Chilean companies. After the 2008 economic crisis, building on the experience of countercyclical lending after the debt crisis in the 1980s, CORFO became an important financial institution in support of private companies although its scale of financing has been fairly small and has been declining in recent years. In 2014, a new strategy was launched, focused on supporting the process of structural transformation and diversification of the Chilean industry and increasing productivity (Griffith-Jones, Martínez Sola, and Petersen Muga, 2018).

China - China Development Bank, CDB

The China Development Bank (CDB), created in 1994, is currently the largest general-purpose DB in the world. Initially established to finance large-scale public investments, CDB accumulated a high number of nonperforming loans (NPL) largely owing to government intervention in the loan approval process. In the ensuing years, important institutional and organizational reforms contributed to enhancing CDB's professional autonomy from the central government, and it rapidly became the leading financial institution in the creation of the bond market and for long-term lending for large investment projects. These included public infrastructure, such as railways and highways, strategic sectors such as oil and chemicals, other emerging industries, and, more recently, renewable energy and electric mobility (Xu, 2016).

South Korea - Korean Development Bank, KDB

In South Korea, the KDB was created in 1954 to support the restoration and reconversion of the industrial sector after the end of the Korean War. In the 1970s, the KDB became the leading financial institution supporting the energy, chemical, and export-oriented industries. Automotive and electronic industries became the main targets of KDB's long-term lending in the 1980s, together with greater opening of the Korean DB toward international markets. In the 1990s, the focus shifted toward support for technology-intensive industries and strengthening corporate banking services, while in the 2000s the KDB operated an expansion and diversification of its activities, focusing on SMEs and balanced economic development (Chandrasekhar, 2016).



Mexico - Nacional Financiera, NAFINSA

In Mexico, NAFINSA was created in 1934 together with two other DBs, and it became the key financial actor to support the political consolidation and economic reconstruction after the end of the revolution in 1921 (Moreno-Brid, Caldentey, and Valdez, 2018). From the 1950s to the 1970s, more than half of NAFINSA's disbursements were directed toward infrastructure. The second main area of interest was the promotion of industrialization, mainly manufacturing. In the 1970s, NAFINSA became the leading institution supporting the ISI strategies of the Mexican government. In the 1980s, a more market-oriented agenda relegated NAFINSA to a marginal role that caused it to revise its strategies in the 1990s toward a more horizontal type of support for micro, small, and medium-sized enterprises (MSMEs). Finally, since the 2000s NAFINSA's disbursement has grown rapidly, together with a shift from public to private targeted companies. In 2015, it disbursed roughly 320 billion Mexican pesos (U\$500 million).

France - Bpifrance

Bpifrance was founded in 2013 by the merging of public institutions and agencies to provide support for innovation and general funding for industry. Although it was one of the youngest DBs, Bpifrance brought together the expertise of historical financial agencies such as the innovation agency Oséo, the department of the Caisse des Dépôts et Consignations CDC Entreprises, and the National and the Regional Strategic Investment Funds (FSI and FSI Régions). Bpifrance's operations grew rapidly, registering a total amount of assets equal to €76.8 billion in 2018, with a particular focus on start-ups, innovation, development, and companies' internationalization and buyout (Thiemann and Volberding, 2021).

Table 1 summarizes the main characteristics of the NDBs selected for this study.



Table 1 • Main Characteristics of the Selected NDBs

	BNDES	Bancóldex	CORFO	NAFINSA	CDB	KDB	Bpifrance
Year Established	1952	1991	1939	1934	1994	1954	2013
Mandate	Transforming the lives of generations of Brazilians by promoting sustainable development	As the bank for entrepreneurial development, it supports productive transformation with an emphasis on small and micro enterprises, supporting innovative firms, export development, and environmental sustainability	Improve the competitiveness and productive diversification of the country through the promotion of investment, innovation, and entrepreneurship, and strengthening human capital and technological capacities to achieve sustainable and territorially balanced development	To contribute to the economic development of Mexico, ..., as well as contributing to the formation of financial markets and acting as trustee and financial agent of the federal government	Mainly engaged in medium and long-term lending and investment to support the implementation of major strategies for medium and long-term development of China's national economy	Establishing and fostering the national economy, industries and infrastructure, and financial and corporate systems	To promote the growth of the French economy by helping entrepreneurs thrive
Personnel	2,000	385 (2020)	1,080 (2020)	996	11,925	3,446	2,289
Yearly disbursement	U\$ 12 bn (2020)	U\$ 1.83 bn (2020)	U\$ 0.38 bn (2020)	U\$ 20.5 bn (2020)	U\$ 1,832 bn (2020)	U\$ 72 bn (2020)	U\$ 49 bn (2020)
of which financing	91% (2020)	100% (2020)	53% (2020)	-	-	-	65% (2020)
% disbursement for innovation	2.9% (2020)	10.1% (2020)*	7.2% (2020)	-	3.8% (2020)	9% (2020)	9% (2020)

Source: Authors' elaboration.

* Credits of "entrepreneurial modernization"

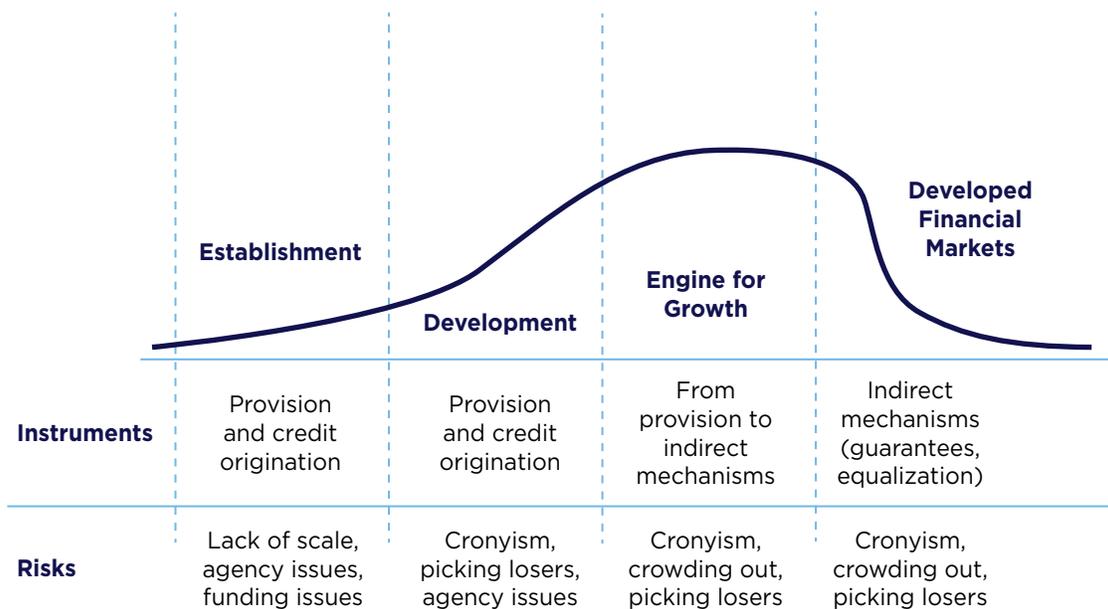
Today, NDBs represent an important source of financing for national economies, particularly for social and industrial development (Rodrik, 2004), through their four main roles: (i) countercyclical, (ii) developmental, (iii) new venture support, and (iv) challenge-led (Mazzucato and Penna, 2016). These enable them to support regions lagging behind in the development process; promote financial inclusion, innovation, and social development; and finance infrastructure investments (Ocampo and Ortega, 2020). Nevertheless, some critiques have been made of NDBs—from financial repression and crowding-out of both commercial bank loans and companies' own resources (Aschauer, 1989; La Porta, Lopez-De-Silanes, and Shleifer,



2002; McKinnon, 1973), the incapacity of picking winners, or willingness to pick losers driven by rent-seeking behaviors (Robinson and Torvik, 2005), and finally misallocation of resources and inefficient governance structure (Carvalho, 2014).

Torres and Zeidan (2016) investigated the similarities characterizing the evolution of several DBs in both developed and developing countries and proposed a life-cycle hypothesis to justify their existence and their roles. Their findings are presented in Figure 1.

Figure 1 • Life-Cycle Hypothesis of Development Banks



Source: Torres and Zeldan (2016).

According to the life-cycle hypothesis, after initial stages characterized by an increasing role of DBs in the countries' development process, their activity is eventually scaled down once financial markets are developed. This raises two main concerns, the first one regarding the definition of "developed financial markets," which is now increasingly related to their level of liberalization, and so it is inevitably accompanied by risks that were already evident well before the 2008 subprime mortgage crisis (Minsky, 1992; Rajan, 2006) but strongly confirmed after it. The second concern is about the concept that developed financing institutions will eventually have both capacities and capabilities to provide financial resources for high-risk



investments which are not necessarily profitable from a commercial point of view, such as innovation. Consequently, if the role of DBs vanishes at later stages of development, it remains unanswered which financial institution should provide resources for path-breaking investments once countries develop. This is an important reason so many developed economies have NDBs, and the United States is now in the process of creating a new federal institution for the green transformation (the Green Accelerator Bill in the U.S. Congress). Furthermore, the United States already has the Export-Import Bank, the country's official export credit agency, providing financial resources to facilitate the United States' exports of goods and services, and the Small Business Investment Corporation Programs, which lends government-backed capital to SMEs at below-market interest rates. It is not qualified as a DB, but rather as a licensed private equity fund manager.

Several efforts have already been made to provide an official and worldwide classification of DBs. Xu et al. (2021) have listed five qualification criteria that are easily verifiable across all institutions and allow for a clear identification of DBs compared with other similar public agencies. These criteria cover different areas that can be classified in terms of stand-alone entities, type of disbursed financial instruments, funding sources, mandate, and government steering of corporate strategies. Following these criteria, DBs are public institutions which have legal personalities, dedicated personnel, and financial accounts separate from those of the state, and are not set up to achieve short-term goals; they deploy financial instruments not limited to nonreimbursable grants but including other financial instruments which are either reimbursable or give some returns, including loans, equity, insurance, and guarantees; they can raise their own resources in the market and not only rely on periodic government budget transfers; they have an official development mandate different from the profit-maximizing one of commercial banks; and governments play a steering role in setting their corporate strategies to ensure that DBs fulfill development-oriented mandates.

There are currently six main financial instruments offered by NDBs to support innovation that can be disbursed either directly or indirectly. These are: (i) loans, (ii) guarantees, (iii) grants, (iv) equity investments, (v) venture capital and venture debt, and (vi) insurance and securitization products (Griffith-Jones et al., 2020).

Loans are debt instruments which can either be disbursed via a first-tier channel (direct lending) or through second-tier channels (indirect lending), usually via commercial banks but also via subnational DBs and other public agencies. Direct forms of lending allow for a greater policy influence over forms of indirect lending, which offers a greater geographical presence



through the regional subsidiaries of commercial banks, particularly for those NDBs that don't have regional offices.

Guarantees are particularly useful financial debt instruments in contexts of high embedded risk and during economic downturns—as in the 2008 subprime mortgage crisis or in the 2020 COVID-19 pandemic—when the guarantee of publicly owned capital plays a major role in encouraging the disbursement of financial resources as a consequence of the state bearing the risk (Anginer, De la Torre, and Ize, 2011; Arrow and Lind, 1970). Importantly, although guarantees have similarities with loans, they differ particularly in terms of developmental impact (Fernández-Arias and Xu, 2020).

Grants are nonreimbursable financial instruments that can cover entirely or partially the investment in projects with high social and developmental returns that are not profitable (or insufficiently profitable) commercially at the time, making them unattractive to the private financial sector.

Equity investments are financial instruments that, contrary to more traditional debt instruments, allow NDBs to potentially capture the upsides in the face of higher risk assumed by the bank. Equity investments can be made directly by the bank, with a direct participation in the funded company, or indirectly through funds of funds, venture capital, or venture debt funds.

Venture capital is a form of equity investment where several partners pool resources into funds to invest the capital in exchange for equity participation in start-up companies. This form of support is becoming more popular across NDBs because of the increasing short-termism of the private venture capital market (Mazzucato and Penna, 2018). However, in developing countries resources from venture capital are still limited (Griffith-Jones et al., 2020; Ocampo and Ortega, 2020).

Venture debt is a financial instrument that combines the characteristics of both venture capital and debt instruments (Griffith-Jones and Carreras, 2021). This quasi-equity type of financial instrument allows companies to raise additional liquidity without an immediate exchange of shares in the equity—but often with the presence of an equity kicker or warrant, which would increase the payment if companies' performance were particularly high. The European Investment Bank, among others, has successfully pioneered this instrument.

Insurance and securitization products are financial instruments used by NDBs to absorb risk partially or completely when it is particularly high. Insurance products are generally used by exporting companies, while NDBs use securitization products to bundle their existing loans



into products to resell in the market and free up new lending resources. It is important to remember the high risk embedded in this financial instrument, bearing in mind the past experience of the subprime mortgage crisis in 2008.

1.1 Key Capabilities Required to Identify, Implement, and Evaluate Programs to Support Innovation Investments

The ability to design and implement successful policies and investments is strongly influenced by the quality of the support that is offered. This quality, in turn, depends on the set of technical, operational, and political capabilities of public institutions (Cornick et al., 2018; Crespi, Fernández-Arias, and Stein, 2014b).

Technical capabilities include financial as well as technological knowledge and expertise needed to successfully design and implement a project. They include both the professional and highly specialized skills (including by engineers and scientists) and the bureaucratic and financial skills necessary to perform all activities within the institution. Thus, NDBs need to have the specialized expertise that enables them to anticipate technological trends and industrial prospects, to successfully assess the economic risks that may go well beyond the risk appetite of private commercial banks, and finally to provide the appropriate financial instrument as well as select the right set of beneficiaries.

Operational capabilities include the managerial and organizational skills that allow a project to be executed effectively, collaborating with other agencies in the system. High-risk investments require proactive collaboration of different stakeholders and financial instruments compared with other types of investments.

Political capabilities, or capabilities of public governance, are the skills that prevent NDBs from being captured by political interests that go beyond their mandate, such as channeling inexpensive funds to politically connected firms. For NDBs, this firewall against political capture can be achieved by guaranteeing a long-term mandate and a stable source of funding that transcends political cycles. NDBs also need to work closely with the private sector (both financial and nonfinancial) while avoiding capture by narrow private interests.



1.2 Comparative Advantage of Development Banks Compared with Other State Interventions

Development banks are one way that the state intervenes in the financial system to address market failures and incubate markets. In terms of financing innovation, DBs may possess the following comparative advantages compared with other means of state interventions, such as grant-providing innovation agencies and preferential taxation treatment. The following analysis comes with assumption of an ideal type of DB that may differ from the actual operation of specific and diverse DBs in practice.

First, DBs may be able to mobilize more resources via capital markets than via fiscal resources. DBs often rely on sovereign creditworthiness to issue bonds on capital markets to finance their operations. This may help alleviate the fiscal constraints of national governments that may hinder the deployment of other fiscally dependent instruments. For instance, grant-making innovation agencies and preferential taxation treatment are more likely to face fiscal constraints.

Second, DBs may be able to make long-term and development-oriented investments that bypass the short-termism of political cycles and political capture. Politicians may aspire to achieve short-term goals within their tenure to win elections, but financing innovation is often a long-term endeavor. If DBs enjoy a sufficient level of professional autonomy, they may be able to provide support for long-term innovation projects that may span several tenures of politicians. By the same token, DBs may be able to make decisions based on the merits of the innovation projects instead of channeling funds to politically connected firms. By contrast, innovation agencies often operate within the state, which may be more prone to undue political intervention. Similarly, preferential taxation treatment may be more likely to suffer from rent-seeking.

Last but not least, DBs may possess a high degree of risk tolerance if their liability structure and internal promotion procedure allow for failures of innovation projects. Financing innovation especially at the technological frontier involves a high degree of uncertainty. If funding sources of DBs allow for losses, DBs may be able to take more risks. Likewise, if the promotion procedure allows the staff to engage in risk-bearing activities, DBs may enter into risky ventures that go beyond the risk appetite of commercial banks. By contrast, government credit programs often have fiduciary responsibilities for public money, which may not tolerate losses.



In principle there are two mechanisms to provide finance for innovation projects other than using NDBs: (i) direct financing using grants provided by an innovation agency and (ii) tax credits for innovation projects.

Innovation agencies are organizations that usually operate within the state, receive resources from the public budget only (hence their action is more exposed to the political cycle), and often provide more limited financial support instruments, such as grants. They are also excluded from any international regulatory accord, such as Basel III, which affords them greater operational freedom.

The generic nature of tax credits (for example R&D tax credits) does not favor the type of investment required to support innovation. Further, this indirect form of support tends to exclude SMEs and start-ups in favor of large companies, which are normally the least affected by market failures.



2

Methodology and Data Collection



For this analysis, we collected primary data through in-depth interviews with current or former national development bank (NDB) officials. Flexible semi-structured topic guides were developed using a common set of questions, ensuring that information was collected in a consistent and comparable manner. The information was also validated and supplemented by interviews with stakeholders outside of the NDBs.

We developed a set of questions that were comparable across case studies and grouped in different blocks. Sections A2 and A3 in the Appendix contain the introduction letter and the complete list of questions used for the interviews. The interviews were structured in two parts. The first part was a discussion of the current role of the NDB in supporting innovation, to complement the analysis of the case studies. The second part of the interview directly touched the core of this inquiry: what capabilities are required to enable the successful implementation of appropriate innovation financing, with a specific focus on the NDB's strategies to tackle market failures.

The questions were organized in the following three blocks:

Block A: Recent Role of the NDB in Supporting Innovation

This part of the interview asked how the NDB supports innovation and has been used to characterize the case under analysis. Interviewees were asked questions regarding (i) the NDB's innovation mandate, (ii) the NDB's role within the national system of innovation and the mechanisms of its interaction with civil society as well as its role in the design of public policies vis-à-vis its role in their implementation, and (iii) the NDB's innovation portfolio (statistics on amounts, economic sector, instrument used, and modality of collaboration in its implementation, as in first and second tier).

Block B: Strategies and Institutional Capabilities of the NDB

Questions in Block B were designed to detect how the NDB implements its activities. In addition, the questions identified the capabilities needed to support the strategies implemented by the NDB. This part of the interview extensively discussed the following aspects: (i) learning mechanisms to identify impediments to innovation to choose which market failures to address (through contact with clients or public-private boards, in collaboration with public innovation agencies, governmental guidelines for policy priorities, own research) and how to improve existing programs (effective ex-post program evaluation), (ii) the NDB's design and implementation strategies for innovation financing (how instruments are selected, why



they are or are not implemented with collaborative arrangements), and (iii) institutional capabilities (technical, operational, and public governance) whose availability allows the NDB to support its strategies and run existing programs effectively.

Block C: Self-Evaluation of Programs and Strategies

In conclusion, an open block section asked respondents to evaluate their NDB's operations and related capability constraints. The discussion focused primarily on self-evaluation of the status quo, especially concerning how NDBs evaluate their ongoing programs and investments.

Findings: Comparing Capabilities to Support Innovation Activities across National Development Banks

This section reports the evidence collected in the interviews conducted using the questionnaire described in the previous section. It compares the capabilities of the NDBs selected in support of innovation activities. Section A4 of the Appendix contains a summary of the interviews for each NDB.

NDB Innovation Mandate

The extent to which NDBs support innovation activities is strictly related to each bank's mandate. Those NDBs that wish to support both radical and incremental types of innovation investments define innovation and targets broadly, combining horizontal and vertical programs in support of the entire industrial sector or specific industrial sectors. This is the case for the NDBs of Brazil (BNDES), Colombia (Bancóldex), and France (Bpifrance). On the contrary, the NDBs of Chile (CORFO), China (CDB), South Korea (KDB), and Mexico (NAFINSA) adopted, at least more recently, a narrower definition of innovation and targets, focused on highly innovative investments and sectors.

It is also interesting to observe the evolution of the support for innovation activities among the NDBs. Excluding the more recently established Bpifrance, all other NDBs discussed in this report have a long history and traversed different political cycles that, to different degrees, shaped and influenced the activity of the bank. Countries with greater continuity of politi-



cal, industrial, and innovation policies (China and South Korea)⁹ are also those in which the mandate and activities of the NDB changed less drastically. On the contrary, all of the Latin American selected NDBs went through different phases in their long history, from being leading financial institutions and active players in the economy to having more marginal roles due to changes in national priorities.

⁹ France also belongs to this category of countries, nevertheless the very short history of Bpifrance does not allow for drawing any comparison with the other selected NDBs.



2.1 Interaction with Other Actors in the Design of Public Policies and Activity of Development Banks

The crucial role played by NDBs in the system of innovation implies that these institutions have continuous interactions, both vertical (with government and ministries, which in most cases are also the bank's main or sole shareholders) and horizontal (with other actors in the innovation ecosystem).

With respect to vertical interactions, the extent to which the main shareholder determines the activity of the NDBs or whether the NDBs have some freedom to operate autonomously is a country-specific aspect. Even within a country, it is often related to the political cycle and national priorities. Evidence suggests that currently in Chile, China, Colombia, France, and South Korea, NDBs have an important role together with the government in defining the targets and goals of innovation and industrial policies. This was observed more prominently in the past for the Brazilian NDB, BNDES, specifically during the period 2004–2016. Efforts to improve and strengthen these interactions are ongoing in Mexico.

Horizontal interactions with other innovation agencies, national DBs, regional DBs, multilateral DBs, industry associations, and the private sector are extremely important to complement the existing knowledge and expertise of the NDB and to assess local market conditions. Generally, all of the NDBs analyzed here reported having frequent and proactive interactions with other institutions and actors in the ecosystem, although in countries like Chile additional efforts are needed to improve coordination among actors. In general, horizontal interactions, particularly at the national level, often require a long process of negotiation among the institutions before becoming formal agreements. Among the activities performed with other partners, organizing official events is one of the most successful instruments to strengthen networks among stakeholders. Bpifrance is among the leading institutions for the organization of these events. In addition, multilateral DBs are important partners for NDBs in Latin America. The World Bank, the Inter-American Development Bank (IDB), and the Corporación Andina de Fomento – Banco de Desarrollo de América Latina (CAF) are examples of such partners. In France, Bpifrance works closely with the European Investment Bank (EIB) and the European Investment Fund (EIF). Collaboration with multilateral DBs is extremely important for NDBs in raising financial resources but also in gaining access to their financial programs and networks.



2.2 Innovation Portfolio of National Development Banks

The analysis of the experiences of the NDBs studied shows that they use a wide variety of instruments to meet the demand for financing that for a variety of reasons the private market does not meet. In most cases, NDBs offer both first- and second-tier loans, depending on (i) the mandate given by the government; (ii) its regional presence; (iii) the size of the loan; and (iv) in the absence of regional offices, the need for local soft information.

Of the countries studied, Chile is the only one that offers only second-tier loans (see Table 2 below). One important limitation of CORFO's credit instruments is that since 1990, CORFO has not used direct (or first-tier) credit at all. Many observers view this as an important limitation, especially for more targeted interventions to support particular sectors or activities, such as the green transformation.

BNDES offers a full spectrum of financial instruments to innovative companies, covering all stages of the investment and tailored to the size of the company. Nevertheless, the size of the support offered for innovation is relatively small compared to the overall disbursement of the bank. Since the creation of the innovation division in the 2000s, several specific programs, both horizontal and vertical, have been launched in support of innovation activities. Initially, they were offered mainly through a first-tier channel and more recently mainly with a second-tier channel, in line with the role of the bank to support the development of the national financial system.

In the case of China, an important financial instrument adopted by CDB is loans, with the Technology Loan and the Emerging Industries of Strategic Importance Loan accounting for 1.2 percent and 2.6 percent of CDB's total volume of newly disbursed loans in 2020, respectively. Loans may be either second tier or first tier. First-tier loans directly support large-scale, long-term projects. However, with respect to sci-tech micro, small, and medium-sized enterprises (MSMEs), CDB may resort to second-tier sub-loans, relying on the capabilities of sci-tech MSME platforms to collect local soft information.

Bancóldex also offers credit lines to support innovation. They are mostly second tier and aimed at the modernization of firms. One emphasis of the credit program is support to MSMEs. However, the historical emphasis on second-tier lending is giving way to larger first-tier loans from the institution. The expansion of first-tier lending is being facilitated by the



absorption by Bancóldex of a subsidiary that used to do factoring but is now increasingly involved in lending as well. First-tier activities also expanded rapidly as part of the national policies to confront the COVID-19 pandemic.

The type of support currently offered by the Mexican NDB in support of innovation activities includes mainly traditional financial instruments, such as loans and guarantees mainly disbursed via a second-tier channel. This excludes large projects on renewable energy and sustainability costing more than U\$60 million.

Another important feature of credit policy is defining whether the credits are general in nature or aimed specifically at certain strategic productive sectors. From the case studies, it appears that the vast majority of countries have credit schemes with broad sectoral coverage and also have defined sectors considered strategic that require financing. BNDES changed its strategy over the years and over different political cycles. While over the first period of the twenty-first century a more challenge-oriented approach was key to identifying specific obstacles related to innovation activities in specific sectors of interest—which would then be addressed using targeted programs—today, BNDES's strategy is more horizontal, in line with the priorities and strategies of the federal government. Chile has not defined strategic sectors, with the exception of a program in the nonconventional renewable energy sector.

With respect to the scope of loans, most NDBs focus their credit programs on SMEs. Only in China, Colombia, France, and South Korea do they also meet the needs of large public and private investment projects. Bpifrance, for example, uses seed loans for both pre- and post-fund-raising and traditional loans, usually supporting large projects leading to patent filings.

Another widely used instrument to meet capital needs is equities. All of the institutions offer equity financing, at least indirectly through funds of funds. If done directly, equity instruments are often offered by a separate subsidiary and/or separate funds managed by the NDB, although it is also common for NDBs to participate in external funds. Some NDBs sit on the board of directors of the company. Funds of funds are becoming increasingly more important and efficient in raising capital. Sometimes, the use of equity instruments requires the NDB to find at least one additional partner for the investment.

In China, CDB was chosen as one of the pilot banks for innovating the Investment and Loan Linkage Mechanism (ILLM) where CDB established CDB Capital Technology Venture in 2016 to provide equity investments combined with long-term loans from the CDB parent institution. Compared with the equity-plus-debt carried out by a commercial bank and an external



investment company before the pilot of ILLM, ILLM can effectively reduce transaction costs as CDB set up the fully-owned subsidiary. Since 2007, BNDES has been offering support with equity instruments both directly and through co-investments in funds, tailored to the developmental stage of the company and the project. As such, equity instruments initially included co-investment with funds of angel investors, but also support offered through seed capital funds. More recently, the offer of BNDES included venture capital and venture debt instruments. In 2018, the bank launched its first accelerator program (BNDES Garagem) in partnership with a venture capital fund and an innovation platform. CORFO has investment funds which operate as funds of funds. They are broadly viewed as successful, but because their scale is limited a priority seems to be to increase them significantly. In this regard, Bancóldex has moved to a more active policy: a fund of funds launched in 2019 with a stronger emphasis on venture capital investments. In all funds, the institution retains a minority position, and the management of each fund is in the hands of a private fund (investment) manager, with Bancóldex participating on the boards of each fund. In any case, the size of both mechanisms is relatively small: in 2020, the modernization lines represented 0.1 percent of Colombia's GDP, and the size of the firms in which the equity and venture funds are involved was 0.2 percent of the country's GDP. In Mexico, indirect equity investments through funds of funds are designed at each stage of the innovation process, from seed capital to venture capital and, more recently, venture debt instruments. Bpifrance also uses convertible bonds and equity instruments both directly (in socially responsible companies) and through funds often managed by Bpifrance itself, for companies that have already successfully raised resources from the market.

Guarantees are another commonly used instrument, employed to partially absorb the risk borne by commercial banks. In China, guarantees account for a small share of CDB's total portfolio, even though it provides guarantees for custom duties for firms. Instruments such as syndication and loans for venture capital guiding funds also encourage private participation in financing innovation.

In Chile, guarantees have emerged as a quantitatively important instrument. These guarantees, mainly to commercial banks, can play a useful role in mitigating uncertainty, such as by introducing new technologies. They are very indirect instruments; thus, they limit CORFO's ability to steer policy.

Subsidies are a common tool used by NDBs, especially when innovative project proposals face particularly high interest rates in local financial markets. Chilean CORFO has a strong emphasis on subsidies, which have in recent years (except 2020) been among the main in-



struments it has used, both in general and for funding innovation. Indeed, within the subsidies granted by CORFO, important categories are technological capacities and innovation. Within other categories, such as entrepreneurship and territories, there are also important elements of innovation.

Bpifrance's support for innovation activities includes scholarships in the form of subsidized loans to cover the initial costs of the investment, grants, recoverable advances, and zero-interest loans to support the validation of the investment and to promote partnerships with foreign companies.

Other instruments used to promote rapid development are accelerators and technical assistance. In Chile, Start-Up Chile is a relatively small instrument of CORFO, but one that has attracted a great deal of attention. It provides initial support to new companies, some of which have become very successful.

The activities of Bpifrance in support of innovative activities are focused on very small businesses and SMEs through a series of programs and instruments specifically designed for each developmental stage of the borrower. Initially, companies are offered a series of programs aimed at structuring the business. They provide access to networks of stakeholders, and services provided include tailored consultancies, accelerators, and face-to-face university programs. Once companies have developed an action plan, the first form of financial support offered by Bpifrance includes short-term credit, mainly to finance cash-flow operations. Internationalization and access to foreign markets, supported with export insurance solutions, and medium- to long-term credit are the financial instruments with the highest disbursement over the last years. They usually precede support for innovation activities, which includes a wide range of instruments designed to cover all phases of the investments, from the maturation and validation phase up to the post-maturation phase when companies have already successfully raised funds from investors.

In South Korea, the KDB was one of the most important institutions to implement government programs to boost the economy focusing on information and communication technology, the creative economy, and green technology. More recently, it adapted its strategy to meet government requirements and became a networking platform for SME start-ups and investors.



Table 2 • Instruments and Services Provided by National Development Banks

Country / NDB	Credit		Size of the loans			Types of programs		Equity & venture funds	Guarantees	Subsidies	Accelerators and technical assistance	Presence of regional offices
	First-tier loans	Second-tier loans	Big	Medium	Small	Horizontal	Vertical					
Brazil BNEDES	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Chile CORFO		✓				✓		✓	✓	✓		✓
China CDB	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Colombia Bancóldex	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
France Bpifrance	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
South Korea KDB	✓		✓	✓	✓		✓	✓	✓	✓	✓	
Mexico NAFINSA	✓	✓					✓	✓	✓			

Source: Authors' elaboration.



2.3 Learning Mechanisms to Identify Impediments to Innovation

The differentiated performance among countries and regions in their patterns and processes of catching up raises significant policy issues and challenges. One of them is the role of capabilities in productive transformation. Mainstream growth models have largely neglected capabilities (defined as the capacity to define the feasible patterns and processes of productive transformation). These models view economic development as a process of production factor and technology accumulation, assuming a mechanistic relationship between investment in productive capacities and growth, with market forces driving the accumulation and growth process.

Thus, capabilities in this context are expressed in the options defining the scope and nature of productive transformation and in the competencies that allow countries to translate options into productive capacities. To develop these skills, the learning process is fundamental not only at the individual level but also at the collective level of social groups—in enterprises, organizations, the economy, and society as a whole. In addition, learning itself represents a capability. Learning to learn is therefore a central element of high-performing learning systems in a dynamic economic context. Thus, collective learning is a key component of the capabilities for productive transformation.

Regarding capacity building, some cases studied in Latin American and Caribbean (LAC) countries seem to be based on this model. Meanwhile, the experiences of China, France, and South Korea show greater efforts to develop capacities internally in the NDBs. This follows from the low importance given to capacity building in the cases studied and to the learning mechanism to identify impediments to innovation.

As can be seen in Table 3, different learning mechanisms to identify impediments to innovation have been implemented by the NDBs studied.

Evaluations and Periodic Reviews by Independent Evaluators

It is clear from the case studies that evaluation is not always done internally (with the consequent lack of opportunities for the development of internal capacity) and often focuses mainly on financial aspects. Evaluations should include the developmental benefit, or the pro-



ductive transformation achieved. On the other hand, different countries conduct performance evaluations or evaluations of compliance with performance indicators as a requirement for a successful allocation of funds from the public budget. These evaluations are usually carried out by external teams or national budget offices. To illustrate the case, in Colombia innovation initiatives are subject to evaluations by Bancóldex or the institution in charge of the program, as well as periodic reviews by independent evaluators. The result of those reviews leads to changes in the programs. In the case of equity and venture capital funds, the evaluation is undertaken by the boards of each of them, in which Bancóldex participates.

In Chile, evaluations have been carried out by external consultants. While this ensured the independence of the evaluation, it implied that capacity was not built up internally. The Ministry of Finance has carried out evaluations more recently, but they have been focused on financial aspects.

Formal Links with the System of Science and Technology

This is another important avenue for feedback and constant improvement of innovation-oriented instruments and programs. In the case of Chile, the Technological Capabilities Office (GCT) has been contributing not only to the development of technological capacities enabling innovation and creation of public goods for competitiveness, but also to the strengthening of technological alliances between universities, technology centers, and companies in R+D+i, with a long-term vision that's high impact and mission oriented in prioritized productive sectors. As of 2020, in coordination with the recently created Ministry of Science and Technology (Law 21.105, Article 2), the national system for the promotion of R&D, technological development, and business innovation was reorganized, focusing the scope of action of CORFO on “productive promotion, entrepreneurship and productive or business innovation, technological development for productive purposes and strengthening of human resources for this area.” This implied a transfer to the National Agency for Research and Development (ANID) of the instruments of the GCT that until that time were more linked to the strengthening of the transfer capacities in the universities and those centers whose object was mainly research and development with a focus on a lower technology readiness level, with those that had a vocation of technological development with productive or mission-oriented purposes remaining in CORFO.



In China, the Ministry of Science and Technology (MOST) and CDB have jointly called for the advent of sci-tech MSME platforms. In 2006, together with MOST, CDB released a plan to encourage the setting up of sci-tech MSME platforms with the help of local governments (MOST and CDB, 2006). The plan is intended to encourage existing agencies to partner with CDB for funding by making them the official local agencies for CDB's loans for sci-tech start-ups. The existing agencies may include: (i) local science and technology bureaus; (ii) incubators of sci-tech companies affiliated with the committees of new districts, such as Wuhu high-tech incubation service sector, which provides legal, managerial, and resource support for local start-ups; (iii) productivity promotion centers overseen by the Chinese Committee of Productivity Promotion Centers, such as the Shanxi Productivity Promotion Center, which introduces technology, technical experts, and knowledge into local MSMEs; (iv) featured industrial bases, such as the Jiulong Sci-Tech Park commercial-car-featured industrial base, which aims at maximizing the conglomeration of firms in locally featured industries and pouring policy support into them; and (v) guarantee and investment companies for start-ups set up by local governments. The above-described agencies can only apply to act as managerial platforms if they possess the capacity to control financial risks and repay debts; otherwise they are eligible to apply to act as lending platforms (MOST and CDB, 2006).

Compared with traditional MSME sub-loans, the new model for sci-tech MSMEs has incorporated a more comprehensive collaboration and risk-sharing mechanism between the bank, the government, the corporations, and the guarantee companies. In the case of CDB, specialized task forces have been formed within the Committee of MOST-CDB Collaboration to improve cooperation between the bank and the government during the implementation of the plan. MOST actively supports local bureaus of science and technology and high-tech zone management committees in setting up sci-tech MSME platforms, providing funding to these local government sectors through MOST's existing programs. The local government sectors are encouraged to support the development of these platforms by granting funds required for their establishment and providing discounts for any loans made to sci-tech MSMEs through these platforms. CDB provides loans for the sci-tech MSMEs to grow, either directly (if it cooperates with managerial platforms) or through the platforms (if it cooperates with lending platforms). Meanwhile, the guarantee company provides guarantees for the MSMEs (MOST and CDB, 2006). In June 2019, CDB approved its branch in Zhejiang to be the pilot branch for development finance in support of sci-tech innovative MSMEs. Ever since the start of the pilot, the branch has explored the model of “bank-government-corporation-guarantee” cooperation, granting to sci-tech companies in areas ranging from electronic technology, biology, and new material to high-end manufacturing equipment.



Dialogue between National and Local Stakeholders

Meetings between different stakeholders and the presence of regional offices are among the most valuable tools to learn about specific obstacles and market conditions. One of the most frequently used learning mechanisms to identify impediments to innovation is the permanent feedback received by the interest groups to which NDBs provide their services. This generally occurs at the local level and is strengthened to the extent that there are decentralized programs, as shown by the cases of Chile, Colombia, and France.

In the case of Brazil, partnerships and collaboration represent a key aspect of BNDES's activity. The bank constantly worked with other stakeholders in the Brazilian innovation ecosystem. Cooperation agreements are usually signed to complement the offer of financial instruments with those of the partner institutions—who often have greater access to grant instruments but also can take greater risk if not qualified as a DB—and also to develop a common framework of support to innovation activities and to networks among all stakeholders in the ecosystem. Recently, several collaborations have been signed with different types of stakeholders. In recent years, more than 10 sectoral programs have been co-managed with FINEP. In terms of recent collaborations, in 2017 BNDES signed a technical cooperation agreement with the social organization EMBRAPA, and in 2021 it launched a co-investment program to foster innovation activities in the areas of digital transformation, defense, new materials, and social and environmental sustainability. Another technical cooperation agreement was signed in 2017 with the research foundation FAPESP to support small, innovative businesses in their initial stages with financial resources and technical consultancies from associated research centers. The following year, a cooperation agreement was signed with the private nonprofit organization SEBRAE to promote financial and technical support of more than 280,000 MSMEs.

In this regard, the program that is worth highlighting in the case of Colombia is the Productivity Factories, which began in 2018 under Productive Colombia with funds also managed by Fiducóldex. This program offers paid assistance (up to 60 hours, previously 80, with a subsidy of about 70 percent) to individual firms but particularly aims at developing a large-scale market for business assistance in the country. The program offers support to formal firms (medium-sized or large ones) and is coordinated with the Chambers of Commerce. The most important activity of the Regional Competitiveness and Innovation Commissions has been the launching of several regional cluster initiatives. More than 100 have been registered by the public-private cluster network, and 35 have met the highest standards that the network has adopted. These initiatives, managed by the Chambers of Commerce, are networks of private firms in different sectors. They were launched in Medellín in the early 2000s but became a



broader trend after the creation of the regional commissions in 2006 and have been growing over the past decade in several regions (in particular Antioquia, Bogotá-Cundinamarca, Manizales, Norte de Santander, Quindío, Risaralda, Santander, and Valle del Cauca). Although there is no formal review of their effectiveness, experts in the field consider that they have been successful in helping improve business models, developing new products, generating some technological instruments at the regional level (e.g., technology labs, in association with local universities), increasing productivity, and, in some cases, generating new export products.

In France, the support of the local divisions at regional level is crucial to identify specific weaknesses and local market conditions. The constant feedback between regional offices and headquarters allows Bpifrance to continuously revise existing programs and define new ones. Regional divisions are paramount for the activity of Bpifrance, as they allow the bank to have up-to-date knowledge of the local market conditions. In addition, public events are regularly organized to convene stakeholders and collect information about companies' needs and current obstacles to investment.

In South Korea, regular meetings among stakeholders who are part of the KDB network allow the bank to maintain its position as market observer and networking platform. By facilitating meetings between entrepreneurs and investors, together with constant interactions with the government, the KDB can constantly obtain updated information about the main obstacles preventing companies from investing in innovation activities.

For example, the KDB has been one of the main vehicles in supporting the financing of the government's industrial policy through loan disbursements to organizations in key strategic industries. To do so, the bank had to appraise these organizations' economic and risk potential before granting financial assistance and monitor their performance thereafter. This led to the development of competencies in assessing organizational project potential, typically in high-risk industries, and measuring performance using nonfinancial criteria, creating a specialization in technological evaluation performed prior to (or during) offering financial assistance. This helped develop KDB's role from merely financing industrial policy to helping to guide it. With a more recent focus on the strategy of developing innovation through the knowledge economy, the KDB also plays a key role in providing technical assistance along with its financial instruments in innovative areas.

For the market maker activities described above, the government mandate is key. The Financial Services Committee (FSC) is the central government authority that works closely with the KDB and other private financial institutions in South Korea. In the Innovative Growth Poli-



cy Council, FSC policymakers and KDB officials have an open dialogue discussing the sectors in which it is worth investing.

In sum, the efforts by the bank reach far beyond the tasks of a common policy bank, handing out loans and providing liquidity in times of crisis. The KDB has become a networker and a central start-up ecosystem facilitator, amassing information and expertise about innovative sectors and establishing a meeting platform to scale and operate newly developing businesses.

Building Up Internal Capacity on Catching Up

There are a few experiences that demonstrate the effort made to develop internal capacities in the area of productive transformation. Some experiences in China and France are described below.

In China, when evaluating project outcomes, CDB does not simply focus on the performance of individual projects. Instead, it pays more attention to the externalities generated by innovation projects and the fulfillment of national innovation policies. Internally, CDB has made efforts to compile cases on innovative financing mechanisms that demonstrate its role in incubating markets. Externally, the Ministry of Finance evaluates the overall performance of CDB. More efforts must be made to design an evaluation matrix that fits the development-oriented mandate of CDB while taking banking performance indicators into account.

By integrating the expertise of institutions with different strategies and missions, Bpifrance was able to build on an existing set of capacities and skills that allowed the French DB to provide support for innovation and general funding for industry, with an established network of regional and national public and private actors. From Oséo's experience in innovation, Bpifrance integrated its expertise on SMEs, regional offices, existing relationships with SMEs and commercial banks, and, importantly, on the countercyclical response, which became fundamental after the 2008 subprime mortgage crisis. From the department of the Caisse des Dépôts et Consignations CDC Entreprises, Bpifrance integrated 20 years' experience in managing funds of funds, fostering the venture funds industry in France, and links with private investors. This experience became extremely useful with the launch of the National and Regional Strategic Investment Funds (FSI and FSI Régions).



The highly specialized expertise within the French NDB not only allows for more efficient screening and evaluation of projects, but also enables it to offer nonfinancial services to companies. This service is in high demand particularly from very small businesses and SMEs, which often lack knowledge, particularly those that are very young and innovative. Tailored technical and financial consulting services represent one of the most successful nonfinancial products. One of the major strengths of this service is the modality through which it is offered, with the regional team of experts in charge of offering more personalized and closer support to businesses. It is also common that consulting services aimed at reinforcing the business model and supporting start-ups, SMEs, and mid-cap companies in their strategic and operational issues are offered in partnerships with a team of 300 external independent experts, such as in the accelerator programs. Entrepreneurs of businesses in their initial stages can also participate in the program called Bpifrance Université, offering online and face-to-face training to develop the managerial skills of managers and entrepreneurs and give them access to the networking platforms of Bpifrance and multiple events organized with entrepreneurs and other innovation stakeholders. Finally, a series of programs focused on networking completes the list of nonfinancial services offered to companies.

Learning to Learn or Learning-by-Doing

These are the most recurrent modalities used to evaluate instruments that support innovation. That is, as part of the implementation cycle of a new program or initiative, it is designed, implemented, and then evaluated to obtain feedback. Unfortunately, frequently this cycle does not perceive new needs or challenges derived from changes in the environment in a timely manner. As can be seen in the case of Chile, evaluation has played an important role in deciding which instruments offered by CORFO are effective. If an instrument is problematic, it has been modified or even eliminated.

In Mexico, NAFINSA has been able to build strong expertise in a few areas, namely renewable energy and digital online platforms. At the beginning of the twenty-first century, renewable energy became the primary focus of NAFINSA's activity in support of innovation, and since then the Mexican NDB has quickly integrated and developed the necessary knowledge and expertise in a dedicated division. In recent years, the interest in digital online platforms led to the creation of another dedicated division, similar to the previous experience on renewable energy. In both cases, while initially the identification of impediments to innovation activities



was slow and characterized by several difficulties due to the novelty of the activities, NAF-INSA was able to quickly develop experience and tools through a learning-by-doing process.

Specialized Units

The establishment of units specialized in strategic planning and innovation is part of a mechanism to detect opportunities and barriers to innovation in the global product and technology space. The productive capacities space describes a country's existing portfolio of technologies and products it masters at a particular point in time.

After innovation was recognized as a strategic priority for BNDES activity in the early 2000s, a few years were necessary to adapt programs and instruments before they could be deployed to companies. With the organization of a dedicated innovation division within the bank in the early 2000s, competencies and expertise were rapidly integrated and developed, allowing the NDB to expand the set of instruments and programs in support of innovation activities.

In 2015, Chile created the Technological Capabilities Office (GCT). This was the result of the need to specialize a part of CORFO's intervention around technological development programs by mission, deploying those programs and projects in strategic areas of greater scope and duration. They are executed collaboratively between actors in the scientific-technological world and companies, with the aim of developing programs, instruments, and other actions to strengthen the capacities of transfer, adaptation, development, and diffusion of technologies throughout the national innovation ecosystem. Additionally, it develops the public goods necessary for the productive development and strengthening of the regulatory capacities of the state.

The results of the study show the importance of promoting the implementation of an integrated learning strategy that creates capabilities for high-performing patterns and processes of productive transformation. Such a learning strategy embraces education, training, technology, R&D, trade and investment policies, promoting learning in all sectors, at all levels, and in multiple locations, as well as fostering institutions to trigger, accelerate, and sustain these learning processes.



Table 3 • Learning Mechanisms to Identify Impediments to Innovation

	Evaluations and periodic reviews by independent evaluators	Formal links with the system of science and technology	Built up internal capacity on catching up	Learning to learn or learning-by-doing process	National/ local stakeholders' dialogue	Specialized unit
Brazil / BNDES	✓	✓	✓		✓	✓
Chile / CORFO	✓	✓				✓
China / CDB	✓	✓	✓	✓	✓	✓
Colombia / Bancóldex	✓	✓			✓	
France / Bpifrance		✓	✓		✓	✓
South Korea / KDB	✓		✓	✓	✓	✓
Mexico/ NAFINSA	✓	✓	✓	✓	✓	✓

Source: Authors' elaboration.



2.4 Design and Implementation Strategies of National Development Banks for Innovation Financing

In all cases, NDBs closely interact with the government and ministries to define innovation and industrial policies. While the government almost always sets forth the overall strategy, some NDBs have proactively communicated with their governments to improve existing programs based on their practical experience (Brazil, China, Colombia, France, and South Korea). Other NDBs lack such independence and rely primarily on the programs designed by the government (Chile, Mexico).

The varying degree of autonomy may have stemmed from the funding sources of NDBs. For example, in 2018, borrowing from governments and other institutions only accounted for around 3 percent of CDB's funding source (China), whereas in Mexico, financial resources are mainly raised from concessional loans from international organizations. The ability of an NDB to finance itself through the market means that these financial institutions may be able to improve political capabilities.

The degree of autonomy in selecting areas of interest also differs across different political cycles (Brazil, Chile, and Mexico). In some governments, specific sectors are appointed to be the major focus for innovation support, while more conservative governments emphasize horizontal aspects such as entrepreneurship (Chile). Countries with a relatively stable government administration such as China have maintained a relatively constant focus on both, and the heavier emphasis on sci-tech MSMEs was laid gradually through years of reforms and pilot projects, as opposed to the rapid shift seen between different political cycles.



2.5 Institutional Capabilities of National Development Banks

The institutional capabilities of the NDBs are strongly related to the history of NDBs. In terms of traditional financial instruments, some banks have inherited high-quality staff from their predecessor (China, Colombia, France), and the long history of some banks has also allowed them to foster a mature system of staff training and evaluation (Brazil, Colombia, South Korea).

For equity instruments, particularly venture capital and venture debt, expertise has been developed more recently. For Bpifrance, the expertise in equity has come from the merged institutions, all of which had a long history of activity. In the other NDBs, institutional capabilities in equity investment are newly developed, with some setting up specialized subsidiaries (Brazil, China, Mexico).

The internal technical capabilities come from a staff portfolio of engineers and scientists, cooperating with experts in financial instruments and macroeconomic policies (Chile, China). External technical capabilities are also drawn from collaborations to make up for lack of expertise in certain areas (China, Mexico).



2.6 Self-Evaluation of the Activities in Support of Innovation

All of the NDBs analyzed in this project have undertaken ex-ante evaluations of specific investments, particularly in the case of equity investments and first-tier lending. They do not evaluate second-tier lending because the financial institutions directly providing the loan incur the risks. All NDBs undertake ex-post evaluations of their activities, but they are outsourced in some cases (notably Chile), of variable quality, and generally refer only to the financial aspects of their investments. Thus, they help identify nonperforming businesses within the portfolio, but not whether the financial support by NDBs has helped enhance innovation in the country or the sector to which they are providing financial support. The high quality of the evaluations by the French and South Korean NDBs analyzed in this project could serve as examples to improve those conducted by the Latin American institutions.

There is a need for broader self-evaluation of the effects of NDB financing on national innovations, to ensure alignment with national priorities. This should also encompass how innovation financing interacts with science and technology policies. The best example of national self-evaluation is Brazil, where the broader evaluations have fostered the continuation of successful programs as well as the discontinuation of ineffective ones. Colombia also undertakes good evaluations of its productive sector policies, but has not always influenced the reorientation of programs or larger budget allocations to innovation activities.

Strengthening innovation teams is essential. One interesting example is the Mexican initiative to create a new innovation division of its NDB, which is currently defining a new framework to internally evaluate innovation activities. Regular NDB evaluation staff is also essential. The Colombian NDB is a good example in this regard.



Conclusions and Policy Recommendations



The support of national development banks (NDBs) for industrial development has always been linked to national industrial and innovation policies. Nevertheless, NDBs have some autonomy to select areas of interest. The crucial point is the role attributed to NDBs over different political cycles, which is strongly correlated with governments' decisions about their capitalization and, therefore, the availability of resources for the institution. In this context, we have found that the ability of NDBs to raise resources from external sources is key to reducing radical shifts in their strategies and to guaranteeing greater continuity of the financial support offered to the economy over time.

As crucial actors within the system of innovation, all NDBs have repeated vertical interactions with government and ministries and horizontal interactions with other innovation agencies, industry associations, and other DBs (multilateral, regional, and national) in the ecosystem. When proactive, the interaction with political institutions is characterized by constant feedback and reciprocal agreement on the main goals of the policies, while proactive interactions with other innovation agencies and DBs often lead to the creation of programs in partnership. Horizontal collaboration in this context is one of the most successful practices to complement the financial and technical capabilities that NDBs are lacking, providing a way to reduce the time necessary to develop them internally or the cost of integrating them from outside the institution. Periodic self-evaluation of interactions with national government and other innovation authorities must be strengthened, and their results should generate relevant changes in the policy agenda and associated innovation instruments, including those managed by the NDBs themselves.

NDBs rely on a portfolio of tools and instruments that allow them to provide support to different types of companies and investments that are strictly related to their statutes and geographic coverage. Today, most NDBs can make equity investments, at least indirectly through funds and often through a subsidiary specifically dedicated to these types of financial instruments. Not all NDBs can, however, have a seat on the board of directors of the companies where they invest. In terms of loans, decisions on whether to support companies directly with a first-tier channel or through second-tier instruments are generally based on the structure of the NDB and on the necessity to foster the development of national private financial markets. First-tier disbursement allows NDBs greater say in the policy direction, and the extent to which NDBs disburse resources through this channel is more often related to the political cycle than to the degree of agency costs relative to government failures. Second-tier disbursement, by contrast, is necessary when NDBs are not spread out geographically, but are also useful to attract additional financial resources and crowd in private actors, when they are willing to participate in the investments, although this rarely occurs with high-risk



investments. In this regard, additionality of resources is a serious concern for almost all NDBs, and funds of funds currently represent the most successful types of instruments to crowd in additional resources from both private and public sources. Guarantees are also useful financial instruments to partially absorb the risk of highly risk-averse private financial institutions, which can encourage them to provide financial support to companies, particularly where there is high uncertainty about the returns of the projects. Guarantee funds are in some cases independent of the NDB, and this financial instrument requires full political support of the government, which is usually the guarantor of last resort.

We also observe an increasing demand by companies (and commercial banks) for technical support. Today, NDBs have not only excellent financial expertise, but also greater knowledge of the markets, integration in the innovation ecosystem, and better scientific/technological expertise compared to other financial institutions. In addition, events aimed at gathering different stakeholders and strengthening the networks allow NDBs to complement the available information on obstacles to investment and local market conditions. The available information allows NDBs to design and implement strategies for innovation financing, which strictly depends on whether programs are in relation to a specific policy framework. Constant interactions with the government and ministries enable successful implementation of programs, while successful implementation of innovation financing is related to knowledge of national and regional market conditions and to the degree of expertise within the institution.

In addition, the legal status of the bank and its alignment with international regulatory frameworks (Basel III in particular) may represent an additional constraint not faced by other innovation agencies offering similar services (including equity instruments) but not as qualified as NDBs. It is thus necessary to assess whether the status of the NDB is the most appropriate for financial institutions supporting high-risk investments, such as innovation, or whether the status of the relevant innovation agency allows for a greater influence of public financial resources. In addition, it is important to consider whether international regulatory frameworks limit the activities of NDBs, and whether NDBs should be subject to specific regulations, with the general ones applicable only to private financial institutions (Gottschalk, Castro, and Xu, 2022).



References



- Aghion, P. and P. W. Howitt. 1998. *Endogenous Growth Theory*. Cambridge, MA: MIT Press.
- Amsden, A. 2001. *The Rise of the Rest: Non-Western Economies' Ascent in World Markets*. Oxford, UK: Oxford University Press.
- Anginer, D., A. De la Torre, and A. Ize. 2011. Risk Absorption by the State: When Is It Good Public Policy? World Bank Policy Research Working Paper 5893. Washington, DC: World Bank.
- Archibugi, T. D. D., D. Archibugi, J. Howells, and J. Michie. 1999. *Innovation Policy in a Global Economy*. Cambridge, UK: Cambridge University Press.
- Arrow, K. J. 1951. An Extension of the Basic Theorems of Classical Welfare Economics. Proceedings of the Second Berkeley Symposium on Mathematical Statistics and Probability. Oakland, CA: University of California Press.
- Arrow, K. J. and R. C. Lind. 1970. Uncertainty and the Evaluation of Public Investment Decisions. *American Economic Review* 60(3): 364–378.
- Aschauer, D. A. 1989. Does Public Capital Crowd out Private Capital? *Journal of Monetary Economics* 24(2): 171–188.
- Barro, R. and X. Sala-i-Martin. 2003. *Economic Growth*. (2nd edition). Cambridge, MA: MIT Press.
- Bleda, M. and P. Del Rio. 2013. The Market Failure and the Systemic Failure Rationales in Technological Innovation Systems. *Research Policy* 42(5): 1039–1052.
- Block, F. 2014. Democratizing Finance. *Politics & Society* 42(1): 3–28.
- Block, F. L. and M. R. Keller. 2015. *State of Innovation: The US Government's Role in Technology Development*. Abington-on-Thames, UK: Routledge.
- Braczyk, H.-J. and M. Heidenreich. 1998. Regional Governance Structures in a Globalized World. *Regional Innovation Systems* 414: 440.
- Breschi, S. and F. Malerba. 1997. Sectoral Innovation Systems: Technological Regimes, Schumpeterian Dynamics, and Spatial Boundaries. *Systems of Innovation: Technologies, Institutions and Organizations* 1: 130–156.
- Breznitz, D. and D. Ornston. 2013. The Revolutionary Power of Peripheral Agencies: Explaining Radical Policy Innovation in Finland and Israel. *Comparative Political Studies* 46(10): 1219–1245.



- Carlsson, B. and R. Stankiewicz. 1991. On the Nature, Function and Composition of Technological Systems. *Journal of Evolutionary Economics* 1(2): 93-118.
- Carreras, M. and S. Griffith-Jones. 2020. National and Multilateral Development Banks during the 2020 Pandemic: The Role of IADB and CDC during the First Phase of COVID-19. In D. A. McDonald, T. Marois, and D. Barrowclough (eds.), *Public Banks and COVID-19: Combatting the Pandemic with Public Finance*. Kingston, ON, Canada: Municipal Services Project, UNCTAD, and Eurodad.
- Carvalho, D. 2014. The Real Effects of Government-Owned Banks: Evidence from an Emerging Market. *The Journal of Finance* 69(2): 577-609.
- Chandrasekhar, C. 2016. National Development Banks in a Comparative Perspective. In A. Calcagno et al. (eds.), *Rethinking Development Strategies after the Financial Crisis: Volume II: Country Studies and International Comparisons*. New York: United Nations.
- Chang, H.-J. 1994. *The Political Economy of Industrial Policy*. New York: St. Martin's Press.
- . 2002. *Kicking Away the Ladder: Development Strategy in Historical Perspective*. London: Anthem Press.
- . 2003. Kicking Away the Ladder: Infant Industry Promotion in Historical Perspective. *Oxford Development Studies* 31(1): 21-32.
- Chang, Y.-C. and M.-H. Chen. 2004. Comparing Approaches to Systems of Innovation: The Knowledge Perspective. *Technology in Society* 26(1): 17-37.
- Chenery, H. B., S. Robinson, and M. Syrquin. 1986. *Industrialization and Growth*. New York: Oxford University Press.
- Cherif, R. and F. Hasanov. 2019. *The Return of the Policy That Shall Not Be Named: Principles of Industrial Policy*. Washington, DC: International Monetary Fund.
- Christensen, J. L. 1992. The Role of Finance in National Systems of Innovation. In B.-A. Lundvall (ed.), *National Systems of Innovation: Toward a Theory of Innovation and Interactive Learning*. London: Pinter.
- Collins, M. 1988. *Money and Banking in the UK: A History*. London: Croon Helm.
- Cooke, P., M. G. Uranga, and G. Etxebarria. 1997. Regional Innovation Systems: Institutional and Organisational Dimensions. *Research Policy* 26(4-5): 475-491.



- Cornick, J. et al. (eds). 2018. *Building Capabilities for Productive Development*. Washington, DC: Inter-American Development Bank.
- Crespi, G., E. Fernández-Arias, and E. Stein. 2014a. Investing in Ideas: Policies to Foster Innovation. In G. Crespi, E. Fernández-Arias, and E. Stein (eds.), *Rethinking Productive Development*. New York: Springer.
- . 2014b. *Rethinking Productive Development*. New York: Springer.
- Crespi, G., L. F. Garone, A. Maffioli, and E. Stein. 2020. Public Support to R&D, Productivity, and Spillover Effects: Firm-Level Evidence from Chile. *World Development* 130: 104948.
- Dasgupta, S. and A. Singh. 2006. Manufacturing, Services and Premature Deindustrialization in Developing Countries: A Kaldorian Analysis (Research Paper No. 2006/49). Helsinki: UNU-WIDER.
- Davies, R., A. G. Haldane, M. Nielsen, and S. Pezzini. 2014. Measuring the Costs of Short-Termism. *Journal of Financial Stability* 12: 16–25.
- de Aghion, B. A. 1999. Development Banking. *Journal of Development Economics* 58(1): 83–100.
- Diamond, W. 1957. *Development Banks: The Economic Development Institute, International Bank for Reconstruction and Development*. Baltimore: The Johns Hopkins Press.
- Diao, X., M. McMillan, and D. Rodrik. 2019. The Recent Growth Boom in Developing Economies: A Structural-Change Perspective. In M. Nissanke and J. A. Ocampo (eds.), *The Palgrave Handbook of Development Economics*. New York: Springer.
- Dosi, G. et al. 1988. *Technical Change and Economic Theory*. Pisa, Italy: Laboratory of Economics and Management (LEM), Sant’Anna School of Advanced Studies.
- Easterly, W. 2001. *The Elusive Quest for Growth: Economists’ Adventures and Misadventures in the Tropics*. Cambridge, MA: MIT Press.
- Fajnzylber, F. 1990. Industrialization in Latin America: From the “Black Box” to the “Empty Box”: A Comparison of Contemporary Industrialization Patterns. *Cuadernos de la CEPAL* 60.
- Fernández-Arias, E. and J. Xu. 2020. Effective Development Banking: Loans or Guarantees? International Research Initiative on PDBs Working Groups Working Paper No. 171. Paris: Agence française de développement.
- Ferraz, J. C., A. C. Além, and R. F. Madeira. 2013. A Contribuição dos bancos de desenvolvimento para o financiamento de longo prazo. *Revista do BNDES* (40): 5–42.



- Freeman, C. 1987. *Technology Policy and Economic Performance: Lessons from Japan*. London: Pinter.
- . 1995. The “National System of Innovation” in Historical Perspective. *Cambridge Journal of Economics* 19(1): 5–24.
- Freeman, C. and L. Soete. 1997. *The Economics of Industrial Innovation*. 3rd edition. Cambridge, MA: MIT Press.
- Gerschenkron, A. 1962. *Economic Backwardness in Historical Perspective*. Cambridge, MA: Belknap Press.
- Gottschalk, R., L. B. Castro, and J. Xu. 2022. Should National Development Banks Be Subject to Basel III? *Review of Political Economy* 34(2): 249–267.
- Griffith-Jones, S. and M. Carreras. 2021. The Role of the EIB in the Green Transformation: Policy Study. Brussels: The Foundation for European Progressive Studies (FEPS) and the Initiative for Policy Dialogue (IPD).
- Griffith-Jones, S., M. Martínez Sola, and J. Petersen Muga. 2018. The Role of CORFO in Chile’s Development: Achievements and Challenges. In S. Griffith-Jones and J. A. Ocampo (eds.), *The Future of National Development Banks*. Oxford, UK: Oxford University Press.
- Griffith-Jones, S. and J. A. Ocampo. 2016. Future of National Development Banks. In D. Richardson (ed.), *International Encyclopedia of Geography: People, the Earth, Environment and Technology*. New York: Wiley.
- Griffith-Jones, S. et al. 2020. Matching Risks with Instruments in Development Banks. International Research Initiative on PDBs Working Groups Working Paper No. 170. Paris: Agence française de développement.
- Grossman, G. M. and E. Helpman. 1991. *Innovation and Growth in the Global Economy*. Cambridge, MA: MIT Press.
- Haldane, A. G. 2015. The Costs of Short-Termism. *The Political Quarterly* 86: 66–76.
- Haldane, A. G. and R. Davies. 2011. The Short Long. 29th Société Universitaire Européenne de Recherches Financières Colloquium, Brussels, Belgium, May 11.
- Hall, B. H. and J. Lerner. 2010. The Financing of R&D and Innovation. In B. H. Hall and N. Rosenberg (eds.), *Handbook of the Economics of Innovation*, Volume 1. Cambridge, MA: Elsevier.



- Hausmann, R. and D. Rodrik. 2003. Economic Development as Self-Discovery. *Journal of Development Economics* 72(2): 603–633.
- Helleiner, G. K. 1994. *Trade Policy and Industrialization in Turbulent Times*. New York: Routledge and UNU/WIDER.
- Hermann, J. 2010. Development Banks in the Financial-Liberalization Era: The Case of BNDES in Brazil. *Cepal Review* 2010(100): 189–203.
- Hirschman, A. O. 1958. *The Strategy of Economic Development*. New Haven, CT: Yale University Press.
- Kaldor, N. 1978. *Further Essays on Economic Theory*. Brookline, MA: Holmes & Meier Publishers.
- Katz, J. M. 1987. Domestic Technology Generation in LDCs: A Review of Research Findings. *Technology Generation in Latin American Manufacturing Industries*: 13–55.
- Kay, J. 2012. The Kay Review of UK Equity Markets and Long-Term Decision Making. London: Department for Business, Innovation, and Skills, Government of the United Kingdom.
- Keller, M. R. and F. Block. 2013. Explaining the Transformation in the US Innovation System: The Impact of a Small Government Program. *Socio-Economic Review* 11(4): 629–656.
- Kregel, J. 2008. Minsky's “Cushions of Safety,” Systemic Risk and the Crisis in the Subprime Mortgage Market. *Finance & Bien Commun* 31(2): 51–59.
- Krugman, P. 1990. *Rethinking International Trade*. Cambridge, MA: MIT Press.
- Lall, S. 1990. *Building Industrial Competitiveness in Developing Countries*. Paris: OECD Development Centre.
- La Porta, R., F. Lopez-De-Silanes, and A. Shleifer. 2002. Government Ownership of Banks. *The Journal of Finance* 57(1): 265–301.
- Lazonick, W. and M. Mazzucato. 2013. The Risk-Reward Nexus in the Innovation-Inequality Relationship: Who Takes the Risks? Who Gets the Rewards? *Industrial and Corporate Change* 22(4): 1093–1128.
- Lee, K. 2019. *The Art of Economic Catch-Up: Barriers, Detours and Leapfrogging in Innovation Systems*. Cambridge, UK: Cambridge University Press.
- Lewis, W. A. 1954. Economic Development with Unlimited Supplies of Labour. Manchester: The Manchester School. Available at <http://la.utexas.edu/users/hcleaver/368/368lewistable.pdf>.



- Lin, J. Y. 2012. *The Quest for Prosperity: How Developing Countries Can Take Off*. Princeton, NJ: Princeton University Press.
- Lin, J. Y., X. Sun, and Y. Jiang. 2013. Endowment, Industrial Structure, and Appropriate Financial Structure: A New Structural Economics Perspective. *Journal of Economic Policy Reform* 16(2): 109–122.
- Lucas, R. E. 1988. On the Mechanics of Economic Development. *Journal of Monetary Economics* 22(1): 3–42.
- Lundvall, B.-A. 1992. *National Systems of Innovation: An Analytical Framework*. London: Pinter.
- . 2007. National Innovation Systems—Analytical Concept and Development Tool. *Industry and Innovation* 14(1): 95–119.
- . 2016. National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning. In B.-A. Lundvall, *The Learning Economy and the Economics of Hope*. London: Anthem Press.
- Malerba, F. 1993. The National System of Innovation: Italy. In R. R. Nelson (ed.), *National Innovation Systems: A Comparative Analysis*. New York: Oxford University Press.
- . 2002. Sectoral Systems of Innovation and Production. *Research Policy* 31(2): 247–264.
- Mazzucato, M. 2011. The Entrepreneurial State. *Soundings* 49(49): 131–142.
- Mazzucato, M. and R. Kattel. 2020. COVID-19 and Public-Sector Capacity. *Oxford Review of Economic Policy* 36(Supplement_1): S256–S269.
- Mazzucato, M. and C. C. Penna. 2016. Beyond Market Failures: The Market Creating and Shaping Roles of State Investment Banks. *Journal of Economic Policy Reform* 19(4): 305–326.
- . 2018. National Development Banks and Mission-Oriented Finance for Innovation. The Future of National Development Banks. In S. Griffith-Jones and J. A. Ocampo (eds.), *The Future of National Development Banks*. Oxford, UK: Oxford University Press.
- Mazzucato, M. and R. Wray. 2014. Financing the Capital Development of the Economy: A Keynes-Schumpeter-Minsky Synthesis. Levy Economics Institute of Bard College Working Paper No. 837.
- McDonald, D. A., T. Marois, and D. Barrowclough (eds.). 2020. *Public Banks and COVID-19: Combatting the Pandemic with Public Finance*. Kingston, ON, Canada: Municipal Services Project, UNCTAD, and Eurodad.



- McKinnon, R. I. 1973. *Money and Capital in Economic Development*. Washington, DC: Brookings Institution Press.
- Ministry of Science and Technology (MOST) and China Development Bank (CDB). 2006. Guide for Constructing Sci-Tech MSME Lending Platforms.
- Minsky, H. P. 1981. Financial Markets and Economic Instability, 1965–1980. *Nebraska Journal of Economics and Business*: 5–16.
- . 1992. The Financial Instability Hypothesis. Levy Economics Institute of Bard College Working Paper No. 74. Available at <http://dx.doi.org/10.2139/ssrn.161024>.
- Missio, F. J., F. G. Jayme Jr., G. Britto, and J. Luis Oreiro. 2015. Real Exchange Rate and Economic Growth: New Empirical Evidence. *Metroeconomica* 66(4): 686–714.
- Moreno-Brid, J. C., E. P. Caldentey, and L. Valdez. 2018. Changing Challenges in the Modernization of Nacional Financiera: Mexico's Key Development Bank. In S. Griffith-Jones and J. A. Ocampo (eds.), *The Future of National Development Banks*. Oxford, UK: Oxford University Press.
- Nelson, R. R. (ed.). 1993. *National Innovation Systems: A Comparative Analysis*. New York: Oxford University Press.
- . 1996. *The Sources of Economic Growth*. Cambridge, MA: Harvard University Press.
- Nelson, R. R. and S. G. Winter. 1982. *An Evolutionary Theory of Economic Change*. Cambridge, MA: Belknap Press.
- Ocampo, J. 1986. New Developments in Trade Theory and LDCs. *Journal of Development Economics* 22(1): 129–170.
- . 2017. Dynamic Efficiency: Structural Dynamics and Economic Growth in Developing Countries. In A. Noman and J. E. Stiglitz (eds.), *Efficiency, Finance, and Varieties of Industrial Policy*. New York: Columbia University Press.
- . 2020. Industrial Policy, Macroeconomics, and Structural Change. In A. Oqubay, C. Cramer, H.-J. Chang, and R. Kozul-Wright (eds.), *The Oxford Handbook of Industrial Policy*. Oxford, UK: Oxford University Press.
- Ocampo, J. A. and P. Arias. 2018. Colombia's System of National Development Banks. In S. Griffith-Jones and J. A. Ocampo (eds.), *The Future of National Development Banks*. Oxford, UK: Oxford University Press.



- Ocampo, J. A. and V. Ortega. 2020. The Global Development Banks' Architecture. International Research Conference on Development.
- Ocampo, J. A., C. Rada, and L. Taylor. 2009. *Growth and Policy in Developing Countries*. New York: Columbia University Press.
- Ocampo, J. A. and L. Taylor. 1998. Trade Liberalisation in Developing Economies: Modest Benefits but Problems with Productivity Growth, Macro Prices, and Income Distribution. *The Economic Journal* 108(450): 1523–46.
- Palma, J. G. 2005. Four Sources of De-Industrialisation and a New Concept of the Dutch Disease. In J. A. Ocampo (ed.), *Beyond Reforms: Structural Dynamics and Macroeconomic Vulnerability*. New York: Stanford University Press and World Bank.
- Pérez, C. 2001. Technological Change and Opportunities for Development as a Moving Target. *CEPAL Review* 75.
- . 2002. *Technological Revolutions and Financial Capital*. New York: Edward Elgar Publishing.
- Rajan, R. G. 2006. Has Finance Made the World Riskier? *European Financial Management* 12(4): 499–533.
- Robinson, J. A. and R. Torvik. 2005. White Elephants. *Journal of Public Economics* 89(2): 197–210.
- Rodriguez, F. and D. Rodrik. 2001. Trade Policy and Economic Growth: A Skeptic's Guide to the Cross-National Evidence. *NBER Macroeconomics Annual* 15: 261–325.
- Rodrik, D. 1999. *The New Global Economy and Developing Countries: Making Openness Work*. Washington, DC: Overseas Development Council.
- . 2004. Industrial Policy for the Twenty-First Century. Available at <http://dx.doi.org/10.2139/ssrn.617544>.
- . 2007. *One Economics, Many Recipes: Globalization, Institutions, and Economic Growth*. Princeton, NJ: Princeton University Press.
- . 2008. The Real Exchange Rate and Economic Growth. *Brookings Papers on Economic Activity* 20082: 365–412.
- . 2016. Premature Deindustrialization. *Journal of Economic Growth* 21(1): 1–33.
- Romer, P. M. 1986. Increasing Returns and Long-Run Growth. *Journal of Political Economy* 94(5): 1002–1037.



- Ros, J. 2001. *Development Theory and the Economics of Growth*. Ann Arbor, MI: University of Michigan Press.
- . 2013. *Rethinking Economic Development, Growth, and Institutions*. Oxford, UK: Oxford University Press.
- Saxenian, A. 1991. The Origins and Dynamics of Production Networks in Silicon Valley. *Research Policy* 20(5): 423–437.
- Schumpeter, J. A. 1934. *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*. Cambridge, MA: Harvard University.
- . 1939. *Business Cycles: A Theoretical, Historical, and Statistical Analysis of the Capitalist Process*. Cambridge, UK: Cambridge University Press.
- . 1942. *Capitalism, Socialism and Democracy*. New York: Routledge Classics.
- . 1961. *The Theory of Economic Development*. New York: Routledge Classics.
- . 1962. *Capitalism, Socialism and Democracy*. 3rd edition. New York: Harper Torchbooks.
- Stein, J. C. 2002. Information Production and Capital Allocation: Decentralized versus Hierarchical Firms. *The Journal of Finance* 57(5): 1891–1921.
- Stiglitz, J. E. and B. Greenwald. 2014. *Creating a Learning Society: A New Approach to Growth, Development, and Social Progress*. New York: Columbia University Press.
- Taylor, L. 1991. *Income Distribution, Inflation, and Growth: Lectures on Structuralist Macroeconomic Theory*. Cambridge, MA: MIT Press.
- Thiemann, M. and P. Volberding. 2021. The Rise of Bpifrance: The Rebirth of a Dirigiste State? In D. Mertens, M. Thiemann, and P. Volberding (eds.), *The Reinvention of Development Banking in the European Union: Industrial Policy in the Single Market and the Emergence of a Field*. Oxford, UK: Oxford University Press.
- Thirlwall, A. 2011. *Economics of Development*. London: Macmillan.
- Torres, E. and R. Zeidan. 2016. The Life-Cycle of National Development Banks: The Experience of Brazil's BNDES. *The Quarterly Review of Economics and Finance* 62: 97–104.
- Whitford, J. and A. Schrank. 2011. The Paradox of the Weak State Revisited: Industrial Policy, Network Governance, and Political Decentralization. In F. Block and M. Keller (eds.), *State of Innovation: The U.S. Government's Role in Technology Development*. New York: Paradigm.



- Wray, L. R. 2011. Minsky's Money Manager Capitalism and the Global Financial Crisis. *International Journal of Political Economy* 40(2): 5-20.
- Wray, L. R. and E. Tymoigne. 2008. Macroeconomics Meets Hyman P. Minsky: The Financial Theory of Investment. Levy Economics Institute of Bard College Working Paper No. 543.
- Xu, J., R. Marodon, and X. Ru. 2020. Identifying and Classifying Public Development Banks and Development Finance Institutions. Working Paper No. 192. Paris: Agence française de développement.
- Xu, J., X. Ren, and X. Wu. 2019. Mapping Development Finance Institutions Worldwide: Definitions, Rationales, and Varieties. NSE Development Financing Research Paper No. 1. Beijing: Institute of New Structural Economics at Peking University.
- Xu, J. et al. 2021. What are Public Development Banks and Development Financing Institutions? Qualification Criteria, Stylized Facts and Development Trends. *China Economic Quarterly International* 1(4): 271-294.
- Xu, Q. 2016. China Development Bank: Born Bankrupt, Born Shaper. In S. Griffith-Jones and J. A. Ocampo (eds.), *The Future of National Development Banks*. Oxford, UK: Oxford University Press.



Appendix



A1 Systems of Innovation

The concept of a national system of innovation (NSI), initially introduced by Freeman in the 1980s, was the first attempt to study innovation using a systems approach. The concept of system as aggregation across different actors and their interactions (Lundvall, 2016) and a broad definition of innovation (Freeman, 1987; Lundvall, 1992; Nelson, 1993) represented the core of the NSI framework. Moving away from the perspective of looking at separate and isolated processes, the NSI authors emphasized the importance of several dimensions and roles at the national level, such as the importance of public policies, the role of human capital and R&D investments, and the importance of producer-consumer relationships as well as the interactions between private and public institutions, such as universities and other nonmarket institutions. Consequently, institutions and constant interactions among different actors—themselves strongly shaped by social, institutional, and political factors—are of primary importance in the NSI framework.

The complexity of organization and the multiplicity of subsystems at the national level shed light on the importance of moving away from a more overarching and less formal national approach, such as the one proposed in the NSI framework, toward a more in-depth analysis of the relationship between technology and innovation within specific geographical areas. The concept of a regional system of innovation (RSI) was initially introduced toward the end of the twentieth century (Cooke, Uranga, and Etxebarria, 1997; Braczyk and Heidenreich, 1998) following the increasing interest for companies' interlinkages and geographical proximity (Saxenian, 1991). Building on the experience of the Italian system of innovation, where small and medium-sized companies performed highly innovative activities at smaller local/regional levels (Malerba, 1993), the RSI framework highlighted the importance of formal and, more importantly, informal relationships and interactions among companies within the same cluster. The concept of "regional" itself varies greatly depending on the context, including groups having similar cultural and linguistic features and the simple administrative aggregation of local areas at the national level. Nevertheless, by borrowing many concepts from the NSI approach, a regional approach to studying innovation systems introduced the need for a deeper understanding and identification of factors that could differ substantially at the national level but are similar across geographic areas, such as the development of the financial sector.

Finally, the technological and sectoral systems of innovation (TSI and SSI) are frameworks focused on a specific technology used across different sectors or on the various technologies used within a specific sector. While the technological framework was introduced by Carlsson



and Stankiewicz (1991) and the sectoral framework was developed by Malerba (2002), both approaches focus on technological development and exchange across industries, emphasizing the presence of heterogeneities and specificity across sectors and technologies (Breschi and Malerba, 1997; Archibugi et al., 1999).



A2 Letter for Interviews

Dear ...,

As briefly introduced in my email, we are working on a project funded by the Inter-American Development Bank (IDB) looking at the capabilities needed to implement strategies of National Development Banks (NDBs hereafter) in supporting investments in innovation. More specifically, we aim to investigate 1) How NDBs adopted tailored strategies in tackling different obstacles related to investments in innovation and which are the main required capabilities to ensure that they have maximum development impact; and 2) How NDBs refrained from adopting additional or more complex programs due to insufficient capabilities to handle them well. The emerging evidence will provide a clear understanding of the different types of finance and strategies that have characterized different systems of innovation and which best practices can be generalized to other NDBs depending on the capabilities are their disposal.

We posit that insufficient private financial support for socially efficient investment projects in innovation motivating NDB intervention is often due to i) Knowledge spillovers or externalities (the social return differs from the private return because some of the investment return accrues to third parties); ii) Financial failure (the private investment return is high but private lenders regard it as uncreditworthy); iii) Asymmetric information (private lenders cannot screen projects to assess their individual private returns and incentivize entrepreneurs); and iv) Coordination failures (the realization of project returns requires the joint investments of different firms requiring non-market planning).

During our call, we would like to discuss the key aspects that have characterized the recent support of the NDB to innovation, with particular emphasis on: A) The recent role of the NDB in supporting innovation; B) Strategies and institutional capabilities of the NDB; and C) Self-evaluation of programs and strategies. We annex a model to guide our interview detailing these questions for your consideration. Please adjust as needed to include additional considerations relevant to this project.

- NDB's definition of innovation
- Main obstacles to innovation
- NDB innovation mandate
- Success cases in innovation financing and support - what factors contributed to success and general lessons to be drawn



- Interaction with other actors in the design of public policies and DB's activity
- Innovation portfolio of the NDB
- Learning mechanisms to identify impediments to innovation
- Design and implementation strategies for innovation financing
- Institutional capabilities that NDBs need to acquire, develop internally, or integrate:
 - Technological and technical - not only financial
 - Operational - to implement programs in coordination with clients and partners
 - Of public governance - to ensure political support preserving functional independence to avoid capture

Please, do not hesitate to contact us in case further information is required.



A3 Interview Questions

BLOCK A: RECENT ROLE OF THE NDB IN SUPPORTING INNOVATION		
I) NDB innovation mandate		
- Disbursement for specific sectors vs. specific innovation categories or market failures, at national level vs. regional areas	1) Specific sectors 2) Innovation categories (e.g., green, start-ups) 3) National, regions/geographical areas	
II) NDB role in innovation: interaction with other actors in the design of public policies and DB's activity		
- Design of public policies: Coordination with other national and multilateral DBs, public agencies, political institutions, and civil society	1) Other national and multilateral DBs 2) Other public agencies 3) Political Institutions (government, ministries) 4) Civil society	
- DB's activity: Coordination with other national and multilateral DBs, public agencies, political institutions, and civil society	1) Other national and multilateral DBs 2) Other public agencies 3) Political institutions 4) Civil society	
III) Innovation portfolio of the NDB		
- Preferred financial instrument	1) Loans 2) Guarantees 3) Grants 4) Equity	5) Venture capital 6) Venture debt 7) Insurance 8) Securitization
- Distribution channel	1) First tier 2) Second tier	
- How companies are targeted (example: by size, by sector, etc.)		
- Effort to crowd in additional external resources for the funded project	1) Commercial banks' resources 2) Multilateral and regional DBs 3) Equity capital markets 4) Companies' resources (liquidity, bonds)	



BLOCK B: STRATEGIES AND INSTITUTIONAL CAPABILITIES OF THE NDB

IV) Learning mechanisms to identify impediments to innovation and refine strategies

- Feedback mechanism to learn about investment opportunities, best/worst practices	1) Within the development bank (e.g., calls, research) 2) From funded companies 3) From partners (e.g., commercial banks) i. If partners, please specify:
- NDB ex-post program and strategy evaluations (systematic? consequential?)	

V) The NDB's design and implementation strategies for innovation financing

- Internal process followed to elaborate and vet strategies and programs (how determinant are analytical/research inputs for decisions?)	1) Program justification 2) Financial instrument and channel of distribution 3) Eligibility and pricing parameters
--	--

VI) Institutional capabilities (technical and technological, operational, of public governance)

- Most required capabilities depending on the type of program and strategy	1) Technical and technological 2) Operational (inc. coordination with other agencies) 3) Public governance (of)
- How capabilities are owned by the NDB	
• Technical and technological	1) Acquired 2) Developed internally 3) Integrated (e.g.: with partnerships)
• Operational	1) Acquired 2) Developed internally 3) Integrated (e.g.: with partnerships)
• Public governance (of)	Explain how the governance structure supports or constrains effective NDB innovation-financing strategies

BLOCK C: SELF-EVALUATION OF PROGRAMS AND STRATEGIES

VII) Experiences with adjustments to programs and strategies due to insufficient capabilities

1) Yes (explain) 2) No	If Yes: were the programs: a) Changed (explain) b) Cancelled
---------------------------	--

**VIII) Self-evaluation of impediments in the status quo:
Missing capabilities constraining existing programs or precluding more effective strategies**



A4 Summary of the Interviews: Comparing Capabilities to Support Innovation Activities across National Development Banks

A4.1 National Development Banks' Innovation Mandate

Brazil

Since its creation in 1952, the Brazilian Development Bank (Banco Nacional de Desenvolvimento Econômico e Social, or BNDES) has been Brazil's main financial institution for the implementation of industrial and development policies. Although activities in support of innovation and industrial activities were already in place to facilitate import substitution industrialization in the 1960s, it was only in the mid-2000s that the bank introduced an official definition of innovation, together with a dedicated division and standards and procedures to evaluate projects. Since then, BNDES has rapidly developed a set of horizontal and vertical programs offering a wide range of financial instruments, including direct and indirect equity investments, which have strictly followed the priorities of the different administrations over the years.

Chile

With the return of democracy in the early 1990s, CORFO focused on supporting the competitive capacities of Chilean private companies, especially smaller ones. CORFO's high degree of flexibility and autonomy for decision making enabled it to develop a variety of instruments to encourage entrepreneurship, and it added a focus on entrepreneurial innovation in strategic sectors. In the 2000s, it added an even stronger focus on explicit support for entrepreneurship with an emphasis on technological innovation. As distinct from previous periods, it emphasized market incentives, prioritizing the role of demand. The logic was based on an analysis of how to correct market failures, and the focus of the instruments developed was on meeting the needs of individual companies. Innovation projects were generated based on the initiative of private companies, with the role of CORFO seen as mainly correcting market failures associated with uncertainty, for example by providing nonreimbursable grants for co-financing, to encourage private companies to develop these projects. In the 2004–2008 period, CORFO created Technological Centers for Innovation, as well as other mechanisms, to generate and/or strengthen advanced technological infrastructure and human resources



in technological entities, to stimulate the innovation demand in companies, and to create new products and services with high value and market potential in various sectors. Seven new centers were created in the following areas: Aquaculture, Food and Functional Ingredients; IT Health; Building Industry; Mining; Piloting Tech; Solar Center; and Digital and Advanced Manufacturing. In 2022, it seems likely the new government will also put greater emphasis on a more selective approach of encouraging technological innovation in sectors with greater potential dynamism and contributions to green transformation.

China

The China Development Bank (CDB) has been closely aligned with Chinese national innovation policies. Initial efforts were sector specific. CDB provides lending to the seven “emerging industries of strategic importance” outlined by the State Council. These are energy saving and environmental protection, generation of new information technology, biology, high-end equipment manufacturing, new energy, new material, and new energy vehicles. However, it has relative autonomy in the selection of individual projects within these sectors. Our study suggests that rather than being a follower of national innovation strategies, CDB played an active role in shaping the national innovation policies of the seven emerging industries of strategic importance and providing support for these sectors well before they were officially identified. With the updated national focus on independent R&D, CDB has taken on a new role in supporting a specific innovation category, “mass innovation,” which includes sci-tech micro, small, and medium-sized enterprises (MSMEs). It has been chosen as a pilot bank for the Investment and Loan Linkage Mechanism (ILLM) and has been a key initiator to support the establishment of sci-tech MSME platforms around China. Working closely with the Chinese government, CDB has taken advantage of its strong political capabilities to help shape national innovation strategies in their early stages, serving as an experimental field for innovative policies, which then creates a demonstration effect for commercial banks to follow suit.

Colombia

After the market reforms of the early 1990s, successive Colombian governments have combined trade liberalization with policies to promote competitiveness. Since the mid-2000s, particularly with the policy frameworks adopted in 2008 and 2015, “innovation” has risen in importance on the policy agenda, which is now formally called a “production sector policy.” It has a 10-year framework approved by the National Council of Economic and Social Policies, chaired by the president, the top national authority on economic and social issues. Innova-



tions are understood broadly to include technical change but also new and better-quality products, new production processes, new marketing strategies, and improvements in the organization and administration of firms. Under this policy, there are several programs managed by the Ministry of Trade, Industry, and Tourism. The system of national development banks includes four institutions. Bancóldex, formally the Foreign Trade Bank but today with a much broader agenda, plays the largest role, both through credit financing and technical assistance, but also with a growing array of capital and venture funds it supports. Fiducóldex, the fiduciary of Bancóldex, also administers the funds of the ministry's innovation programs. Following the broad concept of innovation, most policies and bank facilities have a horizontal focus, including a strong emphasis on supporting MSMEs. The other NDBs are the Fondo para el Financiamiento del Sector Agropecuario (Finagro), for the agricultural sector; the Financiera de Desarrollo Territorial (Findeter), for regional development; and the Financiera de Desarrollo Nacional (FDN) for infrastructure development.

France

Problems of coordination among several agencies and financial institutions led to the creation in 2013 of the Banque Publique d'Investissement (Bpifrance), specifically targeting start-ups, innovation, development, internationalization, and buyout of French companies. The newly created NDB quickly developed a set of financial programs and instruments tailored to the needs of companies and stages of investment, following a holistic approach to innovation broadly defined to participate in both low-risk and high-risk investments. Since 2019, greentech, ecotechnology, and health industries of the future have become the core priorities of Bpifrance activities, specifically for the promotion of highly technological and radical innovation for the deep-tech industries.

South Korea

The Korean Development Bank (KDB) was created in 1954 to support the restoration and reconversion of the industrial sector after the end of the Korean War. In the 1970s, the KDB became the leading financial institution supporting energy, chemical, and export-oriented industries. In its early days, the KDB's main focus was on financing the large Korean conglomerates, *chaebol*, which were at the center of the government's industrial policy. Automotive and electronic industries became the main targets of KDB's long-term lending in the 1980s, together with greater opening of the Korean DB toward international markets. In the 1990s, the country expanded economic liberalization with the goal of joining the Organisation for



Economic Co-operation and Development (OECD). The strong position of the KDB in South Korea's economic policy became somewhat inconvenient for the country that embarked on a path toward a liberal market economy. However, the deep disruption caused by the Asian financial crisis in 1998, just one year after South Korea joined the OECD, caused a revival of state-led industrial policy. The KDB was tasked with implementing a large part of the post-crisis reforms. Following a government mandate, the bank's focus was support to SMEs and start-ups in an effort to rebalance the economy away from the dominance of the *chaebol*. Since the early 2000s, the KDB has transformed itself from a financing institution to an innovation agency.

Mexico

The Mexican government defines the mandate and range of activities of the National Finance Bank (Nacional Financiera, or NAFINSA). It sets priorities and strategies in light of the primary tasks of developing Mexico's stock exchange and building up an active open market for government bonds. Current activities mainly focus on second-tier lending with the aim of developing and strengthening the private financial market with two exceptions, namely investment in renewable energy and sustainability projects.



A4.2 Interaction with Other Actors in the Design of Public Policies and Activities of Development Banks

Brazil

BNDES always had frequent and direct interactions for the definition of targets and strategies with the Ministry of Development, Industry, and Foreign Trade, which is the organizational home of the Brazilian NDB, as well as with the Office of the President. As such, the activities and capitalization of BNDES have always been strictly in line with the government's priorities, which have often caused a rapid shift in the strategies and priorities of the bank when new governments come to power. In addition, partnerships and collaborations with innovation agencies and regional and multilateral DBs have always represented an important tool to complement the financial instruments and programs offered to Brazilian companies, although they often require a long process of negotiation among the institutions before becoming formal agreements.

Chile

The Chilean institutional model of support to science, technology, and innovation (STI) policies has been characterized as being based on a division of labor model, whereby the agencies and instruments that support STI are grouped under separate specialized ministries (mainly Ministry of Science, which was fairly recently created, and Ministry of Economy). There have been some critiques that this institutional model is the result of separate initiatives and thus may not have a completely coherent logic. However, efforts have been made to strengthen the institutions and improve their coordination. The current institutional model of Chilean STI has four levels: Strategy, Policy, Implementation, and Execution. The agencies (such as CORFO and the National Agency for Research and Development [ANID, formerly Conicyt]) are linked vertically with their respective ministries, the Ministry of Economy and the Ministry of Science. This facilitates high vertical alignment of strategy and policies in each agency, and with their ministry. However, it requires a major effort to maintain horizontal coordination between agencies and ministries. Furthermore, at the policy level, the budget office of the Ministry of Finance (DIPRES) provides a coordination role via their budget approval and expenditure monitoring; it also performs coordination to ensure horizontal consistency between agencies' implementation from a financial perspective. A significant problem of the Chilean STI model is the limited scale of the resources that the public sector devotes



to this effort, as well as the relatively low participation of the private sector. Thus, the increase in both is likely to be a major objective of the new government.

China

After three rounds of reforms in 1998, the CDB gained considerable operational autonomy by setting up a firewall mechanism in the loan approval process and by financing through the interbank bond market. While projects listed in a series of programs of the Ministry of Science and Technology (MOST) and the National Development and Reform Commission are eligible to apply for CDB's "major technology project loan," CDB has the liberty to fund other projects outside of the list but still in alignment with the Emerging Industries of Strategic Importance outline. The impact of the government on CDB is highly supportive rather than restrictive, and the government sector has been ready to provide additional political support by setting the strategic direction or providing implicit guarantees. Interaction with other social actors is most evident in the case of sci-tech MSME platforms. The role of these platforms complements the CDB's financial strength and industrial expertise, as they provide additional operational and technical capabilities for CDB. Managerial platforms act mainly as an agent, helping CDB to develop, evaluate, and manage clients. The clients then sign the lending contract directly with CDB. In the case of lending platforms, wholesale lending is granted to these platforms, which then grant sub-loans to sci-tech MSMEs. In both cases, CDB plays a steering role in ensuring that funds are used to support innovation.

Colombia

The production sector policy and associated innovation programs are coordinated in Colombia by the Ministry of Trade, Industry, and Tourism. Bancóldex also formally depends on that ministry, but since 2019 it has been part of the Bicentennial Group, which is coordinated by the Ministry of Finance and Public Credit. The Board of Directors of Bancóldex is largely made up of independent members selected by the government, but not government officials themselves, and since 2017 it follows the OECD standards. There is strong coordination with the Ministry of Trade, but much weaker coordination with the government's programs on science and technology, now formally under its own ministry. In fact, the broad concept of innovations used by the production sector policy implies that technological change is not necessarily a priority. The resources available for all these programs from the national government budget are relatively small—no doubt a major problem of production sector policy. There is also an institutional network that includes a network of Regional Competitiveness



and Innovation Councils, with the active participation of local private actors, and particularly of the Chambers of Commerce. The latter play a central role in the promotion of regional clusters, one of the major successes of the current policy, particularly in six important regions of the country.

France

Activities and strategies of Bpifrance are defined in collaboration with the government, in line with national priorities. In addition, since 2014, the French NDB has had constant and direct interactions with the European Commission, the European Investment Bank, and the European Investment Fund for the implementation of several programs that are part of the European Commission's Investment Plan for Europe (EC IPE) launched after the 2008 sub-prime mortgage crisis. It also partners and collaborates with other NDBs, with the aim of jointly co-investing in sector-specific funds. In addition, Bpifrance shares a liaison office in Brussels with other European NDBs to promote greater integration and collaboration among financial institutions. Finally, FSI Régions and the Territorial Bank (Banque des Territoires) are among the major partners of Bpifrance and are crucial for the implementation of regional programs and to promote regional integration, often through the creation of equity funds and accelerators.

South Korea

The KDB closely works with the government to implement industrial and innovation strategies. Over the last 70 years, it has been a leading financial institution supporting Korean industrialization. For the market maker activities, the government sets the agenda for the KDB through the Financial Services Committee (FSC), the central government authority that works closely with the KDB and other public financial institutions in Korea. In this context, KDB officials have an open dialogue discussing the sectors worth investing in. Collaboration and partnership with other Korean NSI actors are a core strategy of the KDB. In the twenty-first century, the bank began researching the market and connecting with innovative entrepreneurs. Among other programs, the bank launched KDB NextRound, a large venture capital program to fund innovation and give start-ups a chance to secure their first financing and develop their idea into a product. The program connects entrepreneurs in South Korea with KDB venture capital investors and facilitates meetings with other private or institutional investors. It also holds meetings abroad to attract foreign investors. With its corporate venture capital fund, the KDB joined forces with the *chaebol* to support corporate investments



in innovation. This supports not only emerging and smaller companies but sets in motion a wider economic collaboration and the creation of a larger innovation ecosystem in the country. The KDB's conversion to an innovation agency after the Asian financial crisis was driven by its in-house activity to fund the innovative sectors but also by its market maker activities encouraging other economic actors to support new business ideas. The result is a nearly fivefold increase in early-stage start-up funding, from 235 to 998 companies between 2011 and 2020. The total number of companies funded through Korean venture capitalists rose from 613 to 2,130 in the same period. In 2020 alone, they received in total KRW 4,304.5 billion.

Mexico

NAFINSA strictly follows the guidelines decided by the government that define the range of actions and activities of the NDB. At the same time, the Mexican NDB collaborates with several international organizations with the aim of raising financial resources and signing collaboration agreements, useful to complement the technical expertise currently lacking within the bank. Over the years, several partnerships and collaborations have been signed with MDBs such as CAF, IDB, and World Bank, but also with other NDBs such as the German KfW.



A4.3 Innovation Portfolio of National Development Banks

Brazil

BNDES offers a full spectrum of financial instruments to innovative companies, covering all stages of the investment and tailored to the size of the company. Nevertheless, the size of the support offered for innovation is relatively small compared to the overall disbursement of the bank. Since the creation of the innovation division in the 2000s, several specific programs—both horizontal and vertical—have been launched in support of innovation activities, initially mainly through a first-tier channel and more recently mainly through a second-tier channel, in line with the bank's role of supporting the development of the national financial system. Since 2007, BNDES has been offering equity instruments both directly and through co-investments in funds, specifically tailored to the developmental stage of the company and the project. Equity instruments initially included co-investment with funds of angel investors, but also support offered through seed capital funds. More recently, BNDES has offered venture capital and venture debt instruments and, in 2018, the bank launched its first accelerator program (BNDES Garagem) in partnership with a venture capital fund and an innovation platform. The bank offers traditional instruments such as loans at later stages of the investments, mainly for the commercialization and expansion phase of the innovative company, with repayment conditions tailored to the size and activity of the borrowing company.

Chile

Chilean CORFO has a strong emphasis on subsidies, which in recent years (except 2020) have been the main instrument it has used in general and for funding innovation. Indeed, within the subsidies granted by CORFO, important categories are technological capacities and innovation. Within other categories, such as entrepreneurship and territories, there are also important elements of innovation. A relatively small instrument, which has nevertheless attracted great deal of attention, is Start-Up Chile, which provides initial support to new companies, some of which have become successful. However, the broader effects of this program have not appeared to be positive on variables such as employment or export. Credits, which used to be a key instrument, had a decreasing share in CORFO operations, except in 2020, when they were used as a countercyclical response to COVID-19. One important limitation of CORFO's credit instruments is that since 1990, CORFO has not used direct (or first-tier) credit at all. Many observers see this as an important limitation, especially for more targeted interventions to support particular sectors or activities, such as green transformation. Guar-



antees have emerged, particularly in the Piñera governments, as a quantitatively important instrument. These guarantees, mainly to commercial banks, can play a useful role particularly in dealing with uncertainty. For example, when introducing new technologies, they are very indirect instruments, and therefore limit the ability for CORFO to steer policy. CORFO has investment funds, which operate as funds of funds; they are seen as broadly successful, but their scale is fairly limited. It is a priority to increase them significantly. As CORFO resources are limited, there are proposals that it should fund itself also on capital markets (especially domestic). Loans from multilateral development banks such as the IDB, which has provided both funding and technical expertise, have been an important source of funding for CORFO.

China

An important financial instrument adopted by CDB is loans, with the Technology Loan¹⁰ and Emerging Industries of Strategic Importance Loan accounting for 1.2 percent and 2.6 percent of CDB's total volume of newly disbursed loans in 2020, respectively. Loans may be either second tier or first tier. First-tier loans directly support large-scale, long-term projects. However, when it comes to sci-tech MSMEs, CDB may resort to second-tier sub-loans, relying on the capabilities of sci-tech MSME platforms to collect local soft information. CDB has also developed a wide array of capabilities in investment, bonds, leasing, and securities. Political support is important, as CDB was able to establish its wholly owned subsidiary, CDB Capital, specializing in investment and asset management in 2009, although the Law of the People's Republic of China on Commercial Banks stipulated that "commercial banks are not allowed to make investments in nonbanking institutions and enterprises within the People's Republic of China." Later, other subsidiaries, such as CDB Capital Technology Venture, CDB Securities, and China-Africa Development Fund, were established. CDB's diversified operational capabilities have enabled it to provide customized financial services to projects across its different stages of development and according to nuanced funding needs, such as equity investment in the highly risky seed stage of a start-up, and ILLM as it grows into its initial stage and growth stage. Furthermore, a variety of instruments allowed CDB to conduct first-tier ILLM without resorting to external operational support, thus reducing potential transaction costs. In addition, instruments such as syndication and loans for venture capital guiding funds also encourage private participation in financing innovation.

¹⁰ Including loans for major technology projects, industry-university-research loans, loans for science and technology parks, sci-tech MSME loans, loans for high-tech start-ups, and loans for venture capital guiding funds



Colombia

Bancóldex has two mechanisms to support innovation. The first one is credit lines, most of them second tier, aimed at modernizing firms. One emphasis of the credit program is support to MSMEs. In this case, the analysis of the relevant projects is conducted by the financial institution that provides the direct loan. However, the historical emphasis on second-tier lending is giving way to larger first-tier loans from the institution. The basic reason is that in normal times, it is less costly for private financial institutions to finance their lending through deposits or bonds, as they do not pay the spread charged for second-tier loans. The expansion of first-tier lending is being facilitated by the absorption by Bancóldex of a subsidiary that used to do factoring but is now increasingly involved in lending. First-tier activities also expanded rapidly as part of national policies to face the COVID-19 pandemic. The second activity is equity and venture funds. In this regard, Bancóldex has moved to a more active policy: a fund of funds launched in 2019 with a stronger emphasis on venture capital investments. In all funds, the institution maintains a minority position and the management of each specific fund is in the hands of a private fund (investment) manager, with Bancóldex participating on the board of each fund. In any case, the size of both mechanisms is relatively small: the modernization lines represented in 2020 0.1 percent of Colombia's GDP, and the size of the firms in which the equity and venture funds are involved was 0.2 percent of the country's GDP.

France

The activities of Bpifrance in support of innovative activities are focused on small businesses and SMEs with a series of programs and instruments specifically designed at each developmental stage of the borrower. Initially, companies are offered a series of programs aimed at structuring the business and giving access to the networks of stakeholders, and services include tailored consultancies, accelerators, and face-to-face university programs. Once companies have developed an action plan, the first form of financial support offered by Bpifrance includes short-term credit, mainly to finance cash-flow operations. Internationalization and access to foreign markets, supported with export insurance solutions, and medium- to long-term credit are the financial instruments with the highest disbursement over the last years. They usually precede support for innovation activities, which includes a wide range of instruments designed to cover all phases of the investments, from the maturation and validation phase to the post-maturation phase, when companies have already successfully raised funds from investors. Bpifrance's support for innovation activities includes scholarships in the form of subsidized loans to cover the initial costs of the investment; grants, recoverable advances, and zero-interest loans to support the validation of the investment and to promote part-



nerships with foreign companies; seed loans for both pre- and post-fundraising; traditional loans, usually supporting large projects leading to patent filing; and convertible bonds and equity instruments both directly—in socially responsible companies—or through funds often managed by Bpifrance itself, for companies that have already successfully raised resources from the market.

South Korea

While still committed to financing Korean industrial policy, in the 2000s the KDB also funded programs for emergent innovative companies, thereby playing a significant role in gradually reviving the developmentalist mindset that dominated Korea in the first decades of state-led industrialization. The KDB was one of the most important institutions to implement the various government programs to boost the economy focusing on information and communications technology (ICT), the creative economy, and green technology. More recently, it adapted its strategy to meet government requirements and became a networking platform for SMEs, start-ups, and investors.

Mexico

In Mexico, NAFINSA's support for innovation activities is primarily focused on renewable energy and digital online platforms, both with a dedicated division within the bank. Other innovation activities are managed by divisions in charge of assessing all types of projects presented to the bank. The type of support currently offered by the Mexican NDB in support of innovation activities includes mainly traditional financial instruments, as loans and guarantees mainly disbursed via a second-tier channel,¹¹ except for big projects on renewable energy and sustainability projects starting at U\$60 million. In addition, indirect equity investments through funds of funds, administered through the subsidiary Fondos de Fondos (Funds of Funds), are designed at each stage of the innovation process, from seed capital to venture capital and, more recently, venture debt instruments.

11. Disbursement via a second-tier channel is done through a network of intermediaries identified by NAFINSA, after a complex selection process.



A4.4 Learning Mechanisms to Identify Impediments to Innovation

Brazil

BNDES has changed its strategy over the years and over different political cycles. While at the beginning of the twenty-first century a more challenge-oriented approach was the key to identifying specific obstacles related to innovation activities in specific sectors of interest that would then be addressed with targeted programs, today the activity of BNDES is more limited to a horizontal strategy, in line with the priorities and strategies of the federal government.

Chile

Evaluation of instruments has played an important role in CORFO. If an instrument is problematic, it has been modified or even eliminated. Such evaluations, in the first phase of the return of democracy, after 1989, also played a positive role in improving the reputation of CORFO as an effective institution given that during the dictatorship it had high levels of losses. Evaluations have been conducted by external consultants, which had positive aspects of independence but implied that capacity was not built up internally. The Ministry of Finance has conducted evaluations more recently, but they have been focused primarily on financial aspects. This is important, but it is valuable to add in the broader development aspects, including innovation (similar to the Chinese case). Here also, a specialized unit linked to CORFO and focused on development impact would be valuable.

China

When evaluating project outcomes, CDB does not simply focus on the performance of individual projects. Instead, CDB pays more attention to the externalities generated by innovation projects and the fulfillment of national innovation policies. Internally, CDB has made efforts to compile cases on innovative financing mechanisms that demonstrate its role in incubating markets. Externally, the Ministry of Finance evaluates the overall performance of CDB. More efforts need to be made to design an evaluation matrix that fits the development-oriented mandate of CDB while considering the bank's performance indicators.



Colombia

Innovation initiatives are subject to evaluations by Bancóldex or the institution in charge of the program, as well as periodic reviews by independent evaluators. The result of those reviews leads to changes in the programs. In the case of equity and venture capital funds, the evaluation is undertaken by the boards of each of them, on which Bancóldex participates. One of the major responsibilities of the National Planning Department is the evaluation of the production sector policy, as part of its own evaluation function. This is an area that has to be more active. Specifically, there is insufficient analysis of the effectiveness of the links between different institutions participating in the implementation of the innovation programs, especially the links with the system of science and technology.

France

In France, the support of the local divisions at the regional level is crucial to identify specific weaknesses and local market conditions. The constant feedback between the regional offices and headquarters allows Bpifrance to continuously revise existing programs and define new ones. Regional divisions are paramount for the activities of Bpifrance, as they allow the bank to have up-to-date knowledge of local market conditions. In addition, public events are regularly organized to convene stakeholders and collect information about companies' needs and current obstacles to investment.

South Korea

Regular meetings across various stakeholders that are part of the KDB network allow the bank to maintain its position of being a market observer and a networking platform. By facilitating meetings between entrepreneurs and investors, and by being in close contact with government officials, the KDB is able to receive updated information about the main obstacles preventing companies from investing in innovation activities.

Mexico

In Mexico, NAFINSA has built up expertise around a few areas, namely renewable energy and digital online platforms. Since the beginning of the twenty-first century, renewable energy has become the primary focus of NAFINSA's activity in support of innovation. Since then, the Mexican NDB quickly integrated and developed the necessary knowledge and expertise in a dedicated division. In recent years, the interest in digital online platforms led to the creation



of another dedicated division, following the previous experience on renewable energy. In both cases, we registered that while initially the identification of impediments to innovation activities was slow and characterized by several difficulties due to the novelty of the activities, NAFINSA has been able to quickly develop the necessary experience and tools through a learning-by-doing process.



A4.5 National Development Banks' Design and Implementation of Strategies for Innovation Financing

Brazil

The government sets strategies and priorities. However, BNDES has played an active and proactive role in this matter, due to the frequent interactions with ministries and the Office of the President. In this regard, the institutional weight of BNDES has changed over the years and political cycles, as has its role in proposing programs. While early in the twenty-first century BNDES could set up mission-oriented and sectoral programs following the identification of specific obstacles and bottlenecks, more recently the identification and design of new programs is in line with the new horizontal strategies of the federal government.

Chile

The National Council of Science, Technology, Knowledge, and Innovation (known as CNCTCI in Spanish) designs the broad innovation strategy. Then, the Ministry of Economy, working with the regional authority, defines the broad policy. Finally, CORFO and the regional authorities implement the policy. In some administrations, clear sectoral priorities have been identified for CORFO, first via the cluster policy and then the strategic sectors (specifically during the first and second Bachelet administrations, although the process began during the Lagos administration). The more conservative governments (President Piñera's first and second terms) emphasized horizontal policies, particularly focusing on entrepreneurial innovation, as defined by the companies themselves. However, during all administrations, the high-quality CORFO staff has chosen good projects to support, and—where necessary—provided technical support for the success of these projects. Finally, it is important to mention the challenges faced to cope with the regional dimension of innovation efforts. Chile has recently taken important steps toward regionalization and decentralization of development policy initiatives and strengthening regional governments. Furthermore, both the new government and the new constitution are likely to increase the emphasis on regional development. It will be key for CORFO and its regional offices to further strengthen their regional capacities to support this regional dimension of development.



China

CDB works closely with the government sector for the design of innovation-financing mechanisms. In terms of project selection, government agencies such as MOST play a leading role in setting the direction of the most strategically important industries. CDB is free to choose specific projects in line with the strategic direction provided by the government. Internally, CDB has set up project appraisal departments to evaluate the viability of projects. In terms of the specific instruments used by the bank to support each project, CDB takes advantage of its comprehensive financial toolset of “investment, loan, bond, lease, and security” and customizes its service according to the needs and characteristics of individual projects.

Colombia

Innovation policies are part of the production sector strategy approved by the National Council of Economic and Social Policies. The Ministry of Trade, Industry, and Tourism implements the policies, and the board of Bancóldex manages specific financing facilities. In this context, it is important to highlight the high quality of the staff of this NDB and its contribution to the adjustment of adopted policies and proposals to the board of changes for deepening of existing programs.

France

While the government sets innovation and industrial strategies and priorities, Bpifrance proactively contributes to the adjustment and deepening of existing programs both at the national and the European level. In addition, Bpifrance chooses some specific areas or sectors of interest and supports them through the implementation of specific programs.

South Korea

In the Innovative Growth Policy Council, the Financial Services Committee (FSC), policymakers, and KDB officials have an open dialogue discussing the sectors worth investing in. Once the council sets the strategic directions, the KDB designs the instruments to implement the programs successfully. The KDB is responsible for collecting internal and external expertise and deciding which companies receive financing according to the guidelines set by the Innovative Growth Policy Council. Officials are tasked with staying alert to new opportunities and continuously researching developments in the Korean start-up ecosystem.



Mexico

The activities and strategies of NAFINSA are defined by Mexico's National Development Plan and the National Development Finance Program, which the government usually revises every four or five years. As such, the Mexican NDB lacks the independence necessary to set programs and areas of intervention and relies on the priorities and strategies set by the government.



A4.6 Institutional Capabilities of National Development Banks

Brazil

Almost 70 years of experience have enabled BNDES to have a highly qualified staff, built through a competitive selection process and continually trained to confront the contemporaneous challenges of innovation in Brazil. Following the creation of the innovation division in the early 2000s, the bank strengthened its financial and technical expertise. In addition, partnerships and collaborations have allowed BNDES to expand its range of activities and complement financial instruments in support of innovative companies. A special subsidiary, BNDESPAR, is in charge of equity investments, both directly and indirectly through funds.

Chile

An important dimension is financial capability. CORFO began as a large institution that funded an important part of Chilean investment in addition to creating many key enterprises. In that period, it had a major impact on industrialization and innovation strategies. Particularly during the military government and in more conservative governments, the scale of its operations (as a share of GDP and of the total financial sector) has declined significantly. Thus, although most of the projects it supports are good ones, the scale of its activities is too small to have a significant impact on improvements in knowledge and innovation. It has incorporated private sector activity to increase productivity and diversify the productive structure of Chile. With respect to technical abilities, CORFO has highly skilled teams, including important cadres of engineers knowledgeable in specific sectors. There is also a tradition of expertise in managing different financial instruments, particularly more traditional ones, such as subsidies, second-tier credits, and guarantees. Venture capital is a relatively new area, where expertise is developing. A proposal of the new government is to separate activities by instrument. This makes sense, as the types of skills and capabilities required to grant second-tier credits are different from those required, for example, for equity instruments, as international experience also shows. With respect to operational capabilities, CORFO works increasingly in an integrated manner within the institution, but also coordinates its activities with the Ministry of Economy, the new Science Ministry, nationally and regionally, as well as implementing institutions, such as universities and research centers. It also collaborates closely with the private sector, though this could be improved. Finally, at a political level, links with policymaking bodies has improved over time, although horizontal integration with institutions such as National Agency for Research and Development (ANID) can be further improved. One aspect that



has improved is the supply of systematic and timely information to the general public and to those studying CORFO. However, further improvement is necessary, which could draw on the international experience.

China

In terms of technical capabilities, CDB was known as an “expert bank” in the early years of development. CDB was born out of the merging of six state-owned investment companies that were created in 1988 to manage and operate fixed-asset investment projects funded by the central government. This endowed CDB with engineering experts, which helped it to fulfill its initial mandate of financing infrastructure, basic industries, and pillar industries in its early years of development. Currently, CDB is innovating its recruitment and promotion system to attract talent in high-tech industries to strengthen its technical capabilities as an “expert bank.” Regarding its operational capabilities, CDB has integrated the respective capabilities of the government, the market, and the bank to support innovation. Government ministries such as MOST act as an entry point for prioritized innovation projects, meaning that projects selected into some programs of MOST are eligible for CDB’s technology loan. CDB also cooperates with venture capital, venture capital guiding funds, and social agencies for technical and managerial support, engaging in wholesale lending to better support high-tech MSMEs. The establishment in 2009 of CDB Capital, the investment subsidiary of CDB, has provided CDB with a mature operating and management system. Furthermore, the establishment in 2016 of CDB Capital Technology Venture, an investment subsidiary specializing in technology investment, strengthened its focus on financing innovation. Finally, with respect to political capabilities, as the development financing institution under the direct leadership of the State Council, CDB is well positioned to tap into political capital to finance innovation. For instance, CDB works closely with the central and local governments to construct a risk-sharing mechanism when financing high-risk innovation projects, and CDB has been a useful vehicle for the government to implement its national policies.

Colombia

The high quality of Bancóldex’s staff has a long history, dating back to the time when the central bank managed the associated credit facilities. It has maintained very high standards in the selection of new staff members, with many good professionals in the market interested in working with the institution because it is a development bank. Once recruited, personnel management also maintains high standards, with constant training to guarantee that they are



in the “forefront of knowledge,” in the words of Bancóldex’s president, and are subject to an annual Balanced Scorecard scheme with constant follow-up. Special teams have been put in place to manage the equity and venture capital investments, as well as the innovations in the bank’s programs, in the latter case under the Office of the President. The experience in managing second-tier lending has a history going back to the late 1960s, whereas the experience associated with investment in equity and venture capital funds has been accumulated over more than a decade under the special team that manages those investments.

France

The creation of Bpifrance in 2013 was an outcome of a merger between the most important French innovation agency (Oséo), the enterprise division of the largest French NDB (Caisse des Dépôts et Consignations, or CDC), and the National and Regional Strategic Investment Funds (FSI and FSI Régions). The existing expertise of these institutions was integrated into the newly created NDB. Since then, several recent programs and instruments have been promoted to foster industrial development and innovation activities. The 48 regional offices of Bpifrance include a team of highly qualified experts who are in charge of the initial assessment of the project, while at the headquarters in Paris, scientific and technical expertise is organized by industrial sector and by stage of the investments.

South Korea

As a longstanding key economic actor in the industrialization and development process of Korea, the KDB developed a highly qualified set of capabilities, which allow the bank to participate in defining strategies and priorities and to conduct internally (with some exceptions) the technological assessments of projects and their financial viability. More recently, the Korean NDB emphasized its role as market maker by allowing other actors to participate in VC investment activities, incentivizing partnerships and collaborations to share the investment risk.

Mexico

Specific technical expertise is mainly limited to green and digital platform activities, while other projects are assessed from either the first-tier or the second-tier division, depending on the channel of distribution of the financial resources. Currently, collaborations and partnerships are the most successful tools used by NAFINSA to overcome the absence of specific expertise in innovation. Nevertheless, the bank aims to expand its newly created innovation division by increasing the number of technical and scientific experts for innovation activities.



A4.7 Self-Evaluation of Activities in Support of Innovation

Brazil

Programs are periodically monitored and evaluated to identify weaknesses and alignment with national priorities. Consequently, it is possible to observe that the most successful programs have continued to operate throughout different political cycles while other programs have been discontinued due to changes in government priorities. This is particularly the case for vertical programs, which in recent years have been interrupted due to a more horizontal industrial and innovation strategy. Long-lasting programs are instead constantly adapted to face contemporaneous challenges. For example, the technological fund FUNTEC, started in 2005 and offering grants for partnerships between firms and technological institutions, has been adapted several times after internal evaluations revealed that the fund's resources were crowding out other activities.

Chile

CORFO has outsourced its evaluation function. This implies that the learning-by-doing of evaluation has not taken place or only to a limited extent within the institution. It may also limit the extent to which there is sufficient dialogue between the evaluators and their colleagues in CORFO. More recently, the Ministry of Finance has evaluated CORFO activities. While this was a valuable exercise, it focused primarily on the financial and profitability dimensions. It is advisable for CORFO to develop its in-house evaluation capacity, focusing on the financial and commercial dimensions as well as the impact of the projects they support to increase innovation and productivity, especially the introduction of new technology and innovation into private sector investment. The recent establishment of the Ministry of Science should add new and valuable elements to such evaluation exercises, as well as to CORFO activities in general. Furthermore, the greater emphasis on regional development, especially in poorer regions, should also be reflected in greater capacities for evaluation at the regional level.

China

In CDB, there is a specialized unit responsible for post-evaluation of development projects. Evaluation of innovation projects needs to go beyond regular financial sustainability standards because of the information asymmetry caused by the technological intensity of such projects. While CDB has recruited many experts specializing in engineering, finance, and



macroeconomic policies since the late 1990s, these experts usually possess a general knowledge of various science disciplines and CDB needs to devote more efforts to recruiting young talent specialized in innovation financing.

Colombia

There are many levels of self-evaluation. They include the self-evaluation of the national production sector policy and its various elements by the National Planning Department, based in turn on the regular evaluations of the different institutions that play a role in that policy. External evaluations of specific programs feed into this process. However, these evaluations have not always been followed up by a reorientation or even elimination of the instruments that have not proven to be sufficiently successful, and limited resources continue to be allocated to innovation policies in general. In the case of Bancóldex equity investments, and particularly of those in venture capital funds, there are ex-ante evaluations by the institution of the funds where it is likely to invest, but decisions about specific investments of the funds are in the hands of their private managers. Bancóldex staff sit on the boards of all of them, and the institution conducts regular ex-post evaluations of its equity investments. According to OECD's 2018 Production Transformation Policy Review, they have increased the appetite for investment in venture capital in the country. As indicated above, at the staff level Bancóldex has a balance scorecard scheme that provides regular evaluation of its personnel.

France

The activities of Bpifrance are periodically revised following the feedback collected by the regional offices. Technical and financial divisions at the headquarters in Paris are in charge of adapting the programs and proposing solutions to the shortcomings to keep projects aligned with both national priorities and local market conditions. A team of experts in public policy evaluation conducts ex-post program evaluation, together with academics either in charge of the evaluation or a part of it who give formal approval of the methodology used by Bpifrance.



South Korea

The KDB constantly evaluates its portfolio of active investments to identify nonperforming businesses, which currently represent the biggest challenge for the bank. The activities performed by the Korean NDB include reference checks, visits to the companies, and rigorous due diligence. In addition, access to companies' data is part of the evaluation process, allowing for an ongoing screening of investment performances.

Mexico

The evaluation of NAFINSA's innovation financing is mainly limited to financial assessment rather than technical assessment of the programs. This represents a limitation of NAFINSA's activity. The bank aims to overcome this limitation in the coming years with the expansion of the newly created innovation division, which is currently defining a new framework to internally evaluate innovation activities. The main challenge currently facing the Mexican DB is the need to increase the number of scientific experts and engineers to reinforce the technical capabilities needed to understand the quality of the projects beyond their financial aspects. In addition, management is currently working on the definition of a matrix to evaluate innovation activities, with the aim of providing a standardized tool within the bank.

