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Models for Financing Clean Infrastructure in Middle Income Countries

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WORKING PAPER

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About CPI

Climate Policy Initiative is a team of analysts and advisors that works to improve the most important energy and land use policies around the world, with a particular focus on finance. An independent organization supported in part by a grant from the Open Society Foundations, CPI works in places that provide the most potential for policy impact including Brazil, China, Europe, India, Indonesia, and the United States.

Our work helps nations grow while addressing increasingly scarce resources and climate risk. This is a complex challenge in which policy plays a crucial role.

About this project

This report was commissioned by the New Climate Economy project, the Brookings Institution, and the London School of Economics in support of the to-be-released paper, "Delivering on Sustainable Infrastructure for Better Development and Better Climate."

This is a working paper and all findings and conclusions presented should be viewed as preliminary and subject to change until finalized.



Executive Summary

Many rich countries can rely upon sophisticated financial systems, established regulation and policy, a large pool of institutional investors and governments with relatively strong financial positions to help them meet the infrastructure investment needs of their relatively slow growing economies. The investment needs of poor countries are often relatively small and these countries can predominantly rely upon the international development community to help them address their needs.

But what if a country is in between? What if it is big and fast growing, with substantial infrastructure investment needs, but immature financial systems and a scarcity of domestic long term investors? Failure to meet these infrastructure investment needs can stunt a country's growth, but wasting money on too much of the wrong infrastructure can wreck an economy. Add to this the challenge of climate

change that can add substantial infrastructure investment needs to countries rich, poor and in-between.

India and Brazil are two countries in this middle ground that have tried very different solutions to address this challenge.

- Brazil has used a highly centralized model with a strong national development bank (BNDES) to provide stable and relatively low cost finance to infrastructure projects.
- India has used a more decentralized approach with a diverse set of public and private financial institutions delivering finance on more or less commercial terms.

We explore both models, using two climate change relevant wind energy projects, to evaluate how the different models influenced the cost and effectiveness of finance for infrastructure.

Table ES1. Potential benefits and drawbacks of the centralized and decentralized models

	BRAZIL – National Development Bank Driven	INDIA –Multiple State Owned and Private Institutions
Potential System Benefits	<ul style="list-style-type: none"> • Greater financial and administrative efficiency • Effective contribution to multiple government policy objectives • Improved liquidity in the financial system 	<ul style="list-style-type: none"> • Greater financial innovation • Increased participation by more financial institutions and private investors • Reduced government interference and other governance issues • Smoother integration of international development finance
Potential Drawbacks	<ul style="list-style-type: none"> • Reduced public and private international investment due to crowding out • Prolonged high interest rate environment • Governance issues due to concentration of decision making 	<ul style="list-style-type: none"> • Higher cost to the system • Uneven investment with shortages in some key sectors • Restricted use of pure project finance models • Reduced leverage of projects leading to increased risk seeking by investors

In theory, the more centralized system should benefit from efficiencies, driven by economies of scale, and enable better control and coordination of development efforts. On the other hand, a more disaggregated system could encourage more innovation and encourage private sector participation to grow more rapidly. We mapped the potential benefits and drawbacks, in theory, of each system (seen in Table ES1) as a strawman against which to evaluate the actual performance of the models in India and Brazil.

But theory does not take into account differences in economies, institutions, resources and cultures that can waylay even the best laid system. Looking into these real projects and their interaction with the financial model yields several important insights:

1. The differences between infrastructure finance in the two countries are smaller than a superficial glance at the two models would suggest.

Despite the difference in models, both countries ended up with public financing dominating these infrastructure projects. Leverage, that is the amount of debt in the project relative to equity, was similar in both and there was little financial innovation in infrastructure finance.

The two models also suffered many of the same problems, including a failure to adopt many of the project finance models, risk assessment, insurance, debt segmentation, and construction finance models that are more commonly found in developed economies.

2. Differences between the two countries have as much to do with differences in policy than with the financing models. In fact, the finance models may be more reflective of the general policy environment rather than a driver of the policy and finance landscape.

In Brazil, a national development bank plays a role alongside a well-developed national regulatory, auction and pricing system.

Development bank finance enables this mechanism to achieve attractive pricing as bidders can secure attractive financing. In many ways the regulatory and development banking systems have been developed together, each taking advantage of the capabilities and impact on the market.

In contrast, there are wide variations in regulation and policy in India, with risks, financial stability, targets and regulation varying from state to state. National level policy does have an impact, but this impact can often be overwhelmed by state level issues in many states around India.

3. Centralized development banking models do, in practice, show clear benefits.

The centralized development banking did foster greater scale than in India. This scale helped achieve financial objectives, ease control to reach government policy targets, and other benefits suggested in the table above.

4. Development bank models could do more than was observed in Brazil

However, the Brazilian model did not achieve some of the potential benefits, including risk transfer and enhanced liquidity in the market.

5. But centralized models can also learn from the checks, practices and safeguards inherent in the decentralized model

These include an ability to foster investment from commercial and international development sources, as well as safeguards.

6. Both of the models reviewed potentially face governance issues.

The centralized model can better support national policy than a decentralized model, an advantage for policy but potentially leading to concerns about financial inefficiency and higher infrastructure costs, as well as governance concerns. The decentralized model, on the other hand, while reducing the potential for governmental interference, can still prompt suboptimal investments for many reasons: if power off-takers are in poor financial health, or the system facilitates relationship-investment practices, or decision making is still centralized under a small set of actors, for example.

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1. Introduction

Physical infrastructure, such as energy, transportation, telecommunications, water, and sanitation systems, can contribute to the sustained growth of a national economy. Done well, investment in infrastructure can create employment, promote the development of new businesses, reduce operating costs, increase industrial competitiveness, and drive innovation, all while limiting the environmental impact of economic growth. Done poorly, investment in infrastructure can crowd out the development of other sectors, remove talent and resources from more productive uses, contribute to environmental degradation, create opportunities for corruption, and decrease competitiveness.

The global economy needs as much as \$93 trillion of infrastructure investment through 2030 – as rich countries repair their aging roads, networks, and systems, while developing countries build new ones. Yet many analysts suggest that global investment is lagging behind the required rate. Annual global investment in infrastructure is around \$2.7 trillion, which is short of the \$3.7 to \$6 trillion of required investment according to estimates from the World Economic Forum (Authers, 2015), the New Climate Economy,¹ and others. While at the macro level the shortage of investment demand is apparent, many investors bemoan the shortage

of investment opportunities in infrastructure projects offering adequate financial returns.

The contradiction between a shortage of supply of investment, on one hand, and a shortage of demand for that investment, on the other, is only apparent. The nature of much infrastructure as a shared public good, often with monopoly characteristics, means that setting a price for infrastructure, allocating risk, and incentivizing efficient investment can be challenging. These three are inextricably interrelated, so a failure on any one of price, risk, or incentives could lead to both a shortage of investment and a shortage of attractive investment opportunities.

Our hypothesis is that there is no singularly appropriate model to meet these challenges. An optimum model will reflect the characteristics of the infrastructure or industry where the investment is needed, as well as the state of the economy and financial markets of the country in question. In general, we believe that the model should evolve as an economy matures and as the industries in that economy develop. In earlier work with the New Climate Economy,² CPI identified how financial solutions could evolve as countries progress from low-income countries – where financial markets are unlikely to be sophisticated and where development should take priority – to high-income countries –

¹ Climate Policy Initiative, 2014. Moving to a Low Carbon Economy: The Financial Impact of the Low-Carbon Transition

² New Climate Economy, 2014. Better Growth, Better Climate. Chapter 6: Financing a low carbon future. <http://2014.newclimateeconomy.report/>

where economic efficiency, identifying and tailoring investment propositions to the most appropriate sets of investments, and the

improvement of environmental performance of infrastructure begin to take priority (see table 1).

Table 1. Models for infrastructure financing are likely to differ with countries' levels of economic development (the example of renewable energy)

High Income Countries	Middle Income Countries w/o Development Banks	Middle Income Countries w/ Development Banks	Low Income Countries
<p>Innovative financial products matching cash flows to appropriate investors</p> <ol style="list-style-type: none"> 1. Municipal finance 2. YieldCos/MLPs 3. Crowd sourcing <p>Adapting industry models to low carbon technologies</p> <ol style="list-style-type: none"> 1. Sector restructuring 2. Demand response and energy efficiency finance <p>Creating new technologies and behaviors</p> <ol style="list-style-type: none"> 1. Innovation and pricing 	<p>Establish development banking models and policy specifically for low carbon needs</p> <p>Dollarization and currency hedging for low carbon projects</p> <ol style="list-style-type: none"> 1. Pricing energy and carbon as global product receiving global capital costs <p>Eventual adoption of HIC business models</p>	<p>Establish policy specifically for low carbon needs</p> <p>Making development finance work better</p> <ol style="list-style-type: none"> 1. Project selection 2. Governance 3. Price signals <p>Eventual adoption of HIC business models</p>	<p>Development is priority while economies are small and emissions are low</p> <p>Domestic financial solutions are infeasible while internal markets are weak</p> <ol style="list-style-type: none"> 1. But grants and paying differential costs can work 2. International offsets <p>Eventual adoption of national development models as economy grows</p>
<p><i>20% reduction of RE cost plus more from innovation</i></p>	<p><i>Reduce government cost for RE subsidy by 30-40%</i></p>	<p><i>Greater share for low carbon energy</i></p>	<p><i>Prepare for growth that is low carbon from the inception</i></p>

Objective and scope

This paper focuses on the challenges faced by rapidly growing middle income countries in financing their infrastructure. These challenges include:

- Established, but relatively weak and unsophisticated financial markets.
- Lower per capita wealth available for investment.
- Younger populations with a lower propensity for long term investment.
- Faster growth implying both a greater need for new infrastructure as well as more competing needs for capital.
- Greater uncertainty in both growth and infrastructure needs, heightening risk to investors.

Together these lead to a relative shortage of long-term capital compared to needs, exacerbated by attractive short term investment opportunities further crowding out long term investment. The growth of the economy coupled with a shortage of investment often leads to higher inflation and higher interest rates with the result that long term infrastructure investment, which is dependent on low cost, long term finance, becomes comparatively more expensive and difficult to finance. Meanwhile, fast economic growth and inflation can lead to currency risk, which may make foreign investment more difficult and less attractive.

Governments of developing countries have tried many different measures to address this challenge. Some build

infrastructure themselves, often through state-owned companies. Others create market or regulatory models designed to encourage both domestic and foreign private investors and companies. Most create models that bridge these two, with financial models that bridge the gap between long and short term investments, or de-risking of projects through government support or guarantees, or through versions of public-private investment.

This paper focuses on the two seemingly very different models employed in Brazil and India, assessing both the potential benefits and drawbacks of each model and how those potential benefits translate into practice once the particular, national circumstances of each country come into play.

Brazil

The Brazilian model relies on the pivotal role of a strong, central national development bank. This bank, Banco Nacional do Desenvolvimento Econômico e Social (BNDES), plays a prominent role in infrastructure financing and policy. In general, and especially because of the current government's Infrastructure Logistics Program, BNDES provides stable and relatively low cost finance to most larger scale infrastructure projects and companies in the country.

India

By contrast, the Indian infrastructure model does not have a singular, centralized national development bank; instead, it includes a decentralized, diverse set of public

and private banks and financial institutions which deliver infrastructure finance on more or less commercial terms.

We identify the advantages and disadvantages of each model through a case study analysis of specific projects.³ Our comparison highlights the unique benefits and challenges of each model, as well as the challenges common to middle income countries across models.

The paper is organized as follows. In Section 2, we develop a framework to anticipate potential benefits and challenges of the two infrastructure financing models. In Section 3, we provide background information about Brazil and India that motivates our cross-country comparison. This background and framework serve as the basis of our case studies, which we present in Section 4. The case studies allow us to highlight the degree to which observed benefits and challenges of the two infrastructure financing models overlap with those predicted. Each case study includes a summary of our observations from each country and deep dives of two illustrative projects. Section 5 presents a comparative analysis of the two models and concludes with the potential role of national development banks (NDBs) in low, middle, and high income countries. The first part of the

Appendix comments on the importance of introducing innovative risk-sharing instruments to national capital markets and suggests that, regardless of infrastructure financing model, middle income countries should prioritize such innovation to attract investments by institutional investors.

³ The case study analysis focuses specifically on wind energy projects to provide a degree of comparability between countries and because power infrastructure is expected to represent the largest share of future infrastructure demand. Additional discussion around this point can be found in Box 1.

Box 1. Choosing renewable energy finance

Our case studies examine investments in power infrastructure, which are expected to comprise the greatest share of infrastructure finance (McKinsey, 2015). Of course, different types of infrastructure present idiosyncratic challenges that may merit distinct models. We thus concentrate more specifically on renewable energy – and wind projects in particular – in both Brazil and India. This degree of specificity provides a particularly rich perspective on infrastructure finance while offering a degree of comparability between countries from which to draw conclusions.

Several traits of renewable energy finance enhance the generalizability of our work:

- Renewable energy projects require public support and the development of incentive models and industry models to coordinate production. Our analysis thus allows us to examine the interaction of finance in a rich policy environment.
- Renewable energy projects typically use both public and private financing. Our focus on renewable energy allows us to understand how different financing models affect funding mixes and costs.
- Renewable energy infrastructure is often built into projects and project financed. In fact, renewables have become one of the major consumers of project finance in many markets. Our case studies include deep dives about discrete projects and deals, providing a more detailed focus on the development of project finance practices in Brazil and India.
- Renewable energy is a cornerstone of sustainable infrastructure, which may be a major driver of future infrastructure needs; at the same time, renewable energy projects help address countries' environmental policy goals. To note, India aspires to add 175GW of renewable energy capacity by 2022. While Brazil has not set an explicit target for additions of renewable energy, wind projects have been the most competitive projects in recent energy auctions. The lessons of our analysis are thus likely to remain relevant in the coming years.

2. Potential benefits and challenges of the Brazilian and Indian infrastructure financing models

At first glance, the differences between Brazilian and Indian financing of infrastructure mirror many comparisons between more centralized and more disaggregated systems. With a national development bank at the center of most infrastructure planning and investment, a more centralized system like that in Brazil should benefit from efficiencies, driven by economies of scale, and enable better control and coordination of development efforts. Alternatively, a more disaggregated system could encourage more innovation and encourage private sector participation to grow more rapidly. Several tensions play out across the spectrum of centralized to decentralized models, including:

- Financial efficiency from the scale of a centralized bank versus financial innovation that can arise from competition

amongst many commercial actors.

- Policy efficiency of centralization versus political interference that this centralization may facilitate.

Additionally, either system could lead to uneven coverage across the infrastructure space, with some sectors failing to secure adequate financing if either a development bank has a narrow mandate, leaving segments uncovered, or a weak commercial market focuses only on those infrastructure segments that offer both scale and attractiveness. The combination of the two systems could create this problem, if a development bank has both a narrow mandate and prevents a robust commercial sector from forming. In table 2 we specify the potential benefits and drawbacks of the two models as seen from an Indian and Brazilian perspective.

We begin by outlining each of these theoretical benefits and drawbacks of the centralized system, against which we will evaluate the Brazilian and Indian systems in Section 4.

Table 2. Potential benefits and drawbacks of the centralized and decentralized models

	BRAZIL – National Development Bank Driven	INDIA – Multiple State Owned and Private Institutions
Potential System Benefits	<ul style="list-style-type: none"> • Greater financial and administrative efficiency • Effective contribution to multiple government policy objectives • Improved liquidity in the financial system 	<ul style="list-style-type: none"> • Greater financial innovation • Increased participation by more financial institutions and private investors • Reduced government interference and other governance issues • Smoother integration of international development finance
Potential Drawbacks	<ul style="list-style-type: none"> • Reduced public and private international investment due to crowding out • Prolonged high interest rate environment • Governance issues due to concentration of decision making 	<ul style="list-style-type: none"> • Higher cost to the system • Uneven investment with shortages in some key sectors • Restricted use of pure project finance models • Reduced leverage of projects leading to increased risk-seeking by investors

2.1 The potential benefits of centralized models

Centralized NDBs are uniquely positioned in the economy due to their links with government, and they are typically large scale. The unique strengths we would expect from the stylized centralized model, discussed here, follow from these characteristics.

Financial and administrative efficiency

There are a number of ways that a centralized national development bank (NDB) can achieve greater efficiency through the scale of its operations, and the ability to achieve lower borrowing and finance costs due either to the scale, diversification,

or implicit government backing. A longer list of potential benefits includes:

- **Economies of scale.** Larger size should enable a bank to amortize costs across more investments and invest in better and more efficient systems.
- **Greater portfolio diversification** by cutting across all sectors of the economy, which should reduce risk and enable cross sectoral learning.
- **Concentrated technical and financial capability** that can lower transaction costs and extend range of investments.
- **Reduced credit risk** that lowers the default risk of developers to the development bank as well as other potential creditors, as the government link carries greater

enforcement power and increases the importance of maintaining relationships.

- **Reduced cost of funds** as the bank could reflect a sovereign credit rating, and borrow in international markets at a lower cost.
- **Concessional debt facilities**, which could reduce the total annual cost of the investment (including the cost of the debt subsidy and finance cost), could be less costly to deliver through a centralized bank.
- **Economies of scope** as the banks' size and remit could enable both debt and equity investments.
- **Reduction of market imperfections**, for instance the shortage of long term debt in high short term interest rate environments.

Contribution to multiple policy objectives

With a single lever to pull and a close relationship to government, a centralized NDB could be an effective and easily deployable tool to meet government objective, through:

- **Accelerated investment** in targeted segments as the

government can push more of the infrastructure it wants in an accelerated fashion

- **Market design and industry development**, which can be advanced through use of loans and investments
- **Reduction of market imperfections**, for instance the shortage of long term debt in high short term interest rate environments.

In particular, a centralized NDB could take a different perspective on certain risks (see table 3) because they have better credit profiles than other financiers, an incentive to invest in growth (and therefore increased tax income), and balance of payments considerations (especially for commodity importers) that may increase centralized NDBs' desires to support import substitution or localization efforts. These different perspectives could yield economy-wide benefits if the bank or government is able to absorb or mitigate certain risks more cost-effectively than private sector investors.

Of course, as we discuss in the drawbacks below, contribution to multiple policy objectives is only an advantage if the policy objectives themselves are appropriate and beneficial.

Table 3. The risk mitigation potential of a centralized NDB

	Type	Mitigation potential
Financing risks	Tenor risk	Could play countercyclical and developmental roles by providing long-term debt.
	Interest rate risk	Could play a financial market-shaping role by signaling a stable long-term interest rate that may not otherwise emerge from the public yield curve.
	Exchange rate risk	Could socialize the costs of managing currency risk by accessing hard currency in international markets and loaning in local currency.
Credit risks	Counterparty risk	May be able to affect whether a public off-taker defaults on payments.
	Environmental risk	May be able to affect the provision of environmental licenses.
	Demand risk	May be able to affect the evolution of markets and regulations.
	Policy/legal risk	May be able to affect legislative changes or nationalization. Policymakers may be less likely to enact policy that affects the viability of investments made by the NDB.

Improved liquidity in the financial system

Finally, a centralized NDB may be able to use its scale to facilitate the liquidity of other investors; in particular, it could structure financing such that other investors could more easily exit and recycle their capital in the economy. Also, in financial markets within high growth environments that are subject to inflationary pressure, sufficiently large banks could signal an “artificial” long term interest rate by lending at that rate. This could address the incomplete nature of some financial markets in such environments, which tend not to be sufficiently thick and liquid to support long term investments.

2.2 The potential drawbacks of centralized models

The economic power provided to centralized NDBs by their relative size and political access poses as many challenges to sustainable infrastructure financing as it does benefits. Primary amongst these concerns are the governance issues which may manifest themselves as substandard lending practices (e.g. avoiding rigorous cost-benefit analyses or politicizing investment policies for development) to outright corruption. Weak governance can be further translated into wider issues; indeed, poor management of development banks can cause macroeconomic issues. In this section we present a

number of the challenges inherent in the centralized NDB-led model.

Reduced public and private international investment due to crowding out

A centralized NDB could encourage private investors, if its presence or policies reduce the risk faced by these investors. Alternatively, a centralized NDB could take over the investment role that otherwise would fall to private investors, including institutional investors.⁴ If a centralized NDB assumes too heavy of a presence, there is a risk that outside investment – from all international investors as well as private domestic investors – could be crowded out. Under such circumstances national economies might experience a number of negative impacts, including:

- **Missing out on the potential benefits of private capital**, including rigorous risk management practices and technical/investment expertise.
- **Misallocation of long term capital**, if the development bank bears risk that could have been borne by another party at a lower cost.
- **Stunted development of the commercial lending sector**. A centralized NDB could reduce the opportunities for

⁴ Appendix A provides a brief primer on the role of institutional investors in infrastructure finance. These investors may be able to deploy the scale of capital required to finance required infrastructure additions because of the assets under their management and their general preference for long-term, fixed-income investments.

commercial bankers in the country in general and prevent the commercial lending sector from growing to support investments outside of those segments targeted by the centralized NDB.

- **Reduced financial innovation**. In the short term, development banks can gather expertise, build systems, and provide solutions that are low cost for the conditions on the ground. However, in the longer term having one player dominate the market can lead to calcification of financial models. New entrants and other competitors will have little room to develop new financial models that take advantage of changes and opportunities in the market, leading to a stagnant system with higher long term financing costs.

Prolonged high interest rate environment

One potential pitfall of the centralized model is that an NDB, in theory, could prolong the same high interest rate environment that the bank is meant to fix. In this argument, the centralized NDB's long term borrowing consumes the capacity of the long term debt market, keeping long term interest rates high and preventing alternative long term investments from accessing this market and creating an alternative marketplace. In Brazil, a country persistently dogged by high interest rates, BNDES has been accused of segmenting the credit

market through issuing large volumes of subsidized loans, thus muting monetary policy transmission and ultimately forcing the central bank to keep interest rate high to maintain price stability.⁵

Governance issues due to concentration of decision making

For any federally-managed financial institution, there is also the risk of political interference in investment decisions. Without strong governance safeguards, there is potential for mismanagement that may result in:

- Tendency to bail out companies that would otherwise be failing.
- Potential use of the centralized NDB as a tool for incumbents to stay in office.
- Potential use of the centralized NDB by employees to maximize personal objectives.

2.3 The potential benefits of decentralized models

As expected, many of the benefits of decentralized models are the mirror image of the drawbacks of the centralized model. These include:

- Greater financial innovation
- Increased participation by more financial institutions and private investors
- Reduced government interference and other governance issues

One potential benefit that merits special mention is the smoother integration of international development finance. Like both domestic and international private investors, a centralized NDB could crowd out international financial institutions and multilateral development banks. A more decentralized model gives more room for international development finance to identify areas where their expertise and focus would be of value to the host country.

2.4 The potential drawbacks of decentralized models

Similarly, the drawbacks of the decentralized model reflect many of the benefits of the centralized model. A few deserve special mention:

- **Higher costs to the system** can arise in a number of ways. For one, multiple lenders pursuing a single project can significantly increase redundant efforts and total administrative costs. Multiple lenders may, themselves, face higher finance costs as they will have less attractive access to international capital markets. They will then need to pass through these higher costs to borrowers. Finally, delivering concessional debt becomes more expensive as the commercial banks will layer another level of management costs and margins onto the projects.

⁵ Peterson Institute for International Economics. <http://www.iie.com/publications/pb/pb15-16.pdf>

- **Uneven investment with shortages in some key sectors**, particularly as some sectors are insufficiently large or attractive enough to justify a commercial bank building up capabilities in the sector. The tendency could be for some large, attractive sectors to suffer from overcapacity and too much attention, while smaller sectors are left uncovered.
- **Restricted use of a pure project finance model.** In emerging markets, commercial lenders often need to rely more heavily on relationships, as the policy support may be insufficient to make non-recourse finance viable without explicit or implicit government support, as might be delivered through the presence of a centralized NDB.
- **Reduced leverage of projects leading to increased risk seeking by investors.** commercial lenders may be less willing to offer higher debt levels without solid policy and government support. One result could be that projects are structured more for equity investors, who often try to increase returns, sometimes by taking on (and managing) higher levels of risk.

2.5 Translating theoretical benefits and drawbacks to real world examples

Things are rarely as clear cut as they appear on the drawing board. The finance models applied in India and Brazil are not the prototypes discussed

here, but rather models that have been built up around the institutions, culture, policy, and economic realities of each country. In many ways, the finance systems of Brazil and India are just one component of the overall regulatory and financial compacts that have been created to manage infrastructure development and finance. In this respect, the banking models may be as much the *result* of system benefits and drawback as they are the *cause* of these benefits or issues. A further observation is that the Indian and Brazilian models are much more similar than they might seem at first inspection. In India, state-owned banks and institutions continue to play a dominant role in the financing of the infrastructure projects we observed. In Brazil, BNDES, for its part, works with private sector players and seeks to encourage their development. In both cases, there is a continual struggle with governance issues.

These differences from the ideal, how they arise, and the impact they have on effectiveness of the various models, is what drives the remainder of this paper. Understanding why an ideal may not be achieved, and what the alternatives could be, should be an important part of developing financing models for infrastructure in rapidly developing countries.

3. Background on Brazil and India

Despite major differences in wealth, Brazil and India face similar challenges in the development and financing of infrastructure. However, there are four key economic differences between the two countries that limit the attribution of differential performance in infrastructure financing to the different models:

1. Brazil is wealthier than India; Brazil's per capita income of \$11,614 (\$16,591 on a purchasing power parity (PPP) basis) is greater than India's \$1,631 (\$5,438 on a PPP basis).
2. Brazil hosts a larger middle class, whether measured by the share of population (48% in Brazil, 8% in India in 2011) or the share of GDP comprised of expenditures by the middle class (32% in Brazil, 10% in India in 2011) (Kaufmann et al., 2012).
3. The distribution of wealth is more unequal in Brazil, which has a Gini coefficient⁶ of 52.7, relative to 33.6 in India.
4. Brazil can generate significant, if volatile, dollar-based revenues through its export of commodities by state-owned enterprises such as Petrobras; 65% of Brazil's merchandise exports are commodity goods,

⁶ The Gini coefficient measures the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution. <http://data.worldbank.org/indicator/SI.POV.GINI>

relative to 31% of India's (UNCTAD, 2015).

The implications of these differences are that (1) public financiers in India would be expected to have fewer resources than those in Brazil and (2) middle and upper class individuals in Brazil could theoretically provide a larger asset base to invest in infrastructure projects through domestic institutional investors.

Nonetheless, important similarities between the two countries imply that our comparison is warranted. In 2014, Brazil and India were the 7th and 10th largest economies on a GDP basis, and 7th and 3rd on a GDP (PPP) basis, respectively (World Bank, 2015). Both countries are large, with populations of 200 million and 1.2 billion in Brazil and India, respectively. They are also young, with median ages of 31 and 27, respectively (CIA, 2015). With these large economies and a young labor force that is unlikely to have yet accumulated the wealth required for domestic institutional investors to lead infrastructure investing, both countries could theoretically benefit from public financing or from policies that encourage foreign institutional investors to finance domestic infrastructure.

Indeed, both Brazil and India face similar challenges in infrastructure financing. While globally 3.8% of GDP was invested in infrastructure between 1992 and 2012, Brazil invested 2.2% of its GDP in infrastructure (Itaú BBA, 2013). Consequently, Brazil's 2012 asset-to-GDP ratio of 0.48 lagged the 2012 global average of 0.71 (Itaú BBA,

2013). Even in India, which invested an average share of GDP in infrastructure, 4.7%, the 2012 asset-to-GDP ratio, 0.58, fell below the global average (Itaú BBA, 2013). Correspondingly, Brazil's infrastructure ranks 74th in the World Economic Forum's 2015 – 2016 Global Competitiveness Index, while India's ranks 81st (WEF, 2015).

Further, the national GDP figures for both countries mask pronounced heterogeneity in the wealth of states and regions; the poorest Brazilian and Indian regions have GDPs (PPP) per capita that are 13% and 10% that of the richest, respectively.⁷ In both countries, public financing institutions could direct finance towards relatively underdeveloped states by, for example, mitigating or accepting some of the risks that may be associated with investing in such regions.

Most significant, however, are macroeconomic similarities. Since the start of the decade, both countries have experienced high inflation, with five-year average inflation rates of 7.2% and 6.6% in Brazil and India, respectively (World Bank, 2015). These high inflation rates help account for the high long term interest rates on debt in both countries, with the ten-year benchmark rate at 14.25% in Brazil and 6.75% in India.⁸ High short term rates in both countries obscure

long term rate expectations, given a belief that the yield curve should be steeply declining from the high short term rates. In the presence of this constant contango, public financial institutions could provide a low long term rate signal.

Finally, the exchange rate of both countries' currencies have been subject to substantial volatility over the past three years; the exchange rate volatility between the Brazilian Real (BRL) and U.S. Dollar (USD) and Euro was 10.53% and 12.04% over the three years leading up to September 2015.⁹ Though the corresponding numbers for the Indian Rupee (INR), 7.73% and 10.03%, were lower, they highlight the currency risk that is characteristic of both economies.¹⁰ Investors in both Brazil and India who would like to access foreign capital markets must find a way to mitigate such exchange rate risk. As Shrimali et al. (2014) show, the hedges that borrowers purchase can account for 56% of the incremental cost of accessing foreign capital.

⁷ Instituto Brasileiro de Geografia e Estatística (IBGE).
ftp://ftp.ibge.gov.br/Contas_Regionais/2012/pdf/tab01.pdf

⁸ As of September 2015 on Trading Economics (www.tradingeconomics.com)

⁹ Trading Economics. Accessed Oct. 2015.
<http://www.tradingeconomics.com>

¹⁰ Trading Economics. Accessed Oct. 2015.
<http://www.tradingeconomics.com>

Table 4. Key similarities and differences between Brazil and India

Key Similarities	Key Differences
<ul style="list-style-type: none"> • Large economies with young populations • Below average infrastructure investment (share of GDP invested) • High wealth disparity across states/regions (geographic) • Macroeconomic factors (e.g. high inflation and high long term interest rates) • Volatile currencies (increases cost of accessing foreign capital) 	<ul style="list-style-type: none"> • Brazil is wealthier than India (3x on PPP basis) • Brazil has a larger middle class • Brazil has higher overall wealth disparity • Brazil has a more commodity-intensive economy (allows the generation of USD based revenue) • Brazil has a highly centralized energy market and power procurement process

Market characteristics

Both countries face keen challenges in adding power infrastructure. Besides a weather-related supply shortage that is rooted in the generation system's heavy reliance on hydroelectric power, Brazil's system faces the expiration of many electricity sector concessions between 2015 and 2017 (Schutze, n.d.). In the generation segment, for example, around 20% of Brazil's installed capacity faces an expiration of its concession. While some of this capacity may receive concession extensions, significant uncertainty surrounds the timing and occurrence of such an extension (Schutze, n.d.). India aspires to add 175GW of low-carbon generation capacity by 2022 to both offset a power demand-supply imbalance and limit the externalities associated with electricity consumption.

While Brazil and India have large power infrastructure needs, capacity additions in each country would join

very different power systems. In Brazil, energy and capacity procurement proceeds through a centralized system of electricity auctions. The Ministry of Mines and Energy (MME) and the National Energy Policy Council (CNPE) develop medium and long term plans for the Brazilian power system which allow them to determine which energy sources should be procured. This decision is passed to the system regulator, the National Electricity Power Agency (ANEEL), which then works with Brazilian distribution companies to determine the parameters of the procurement auctions, including the target generation capacity to procure and the magnitude of price caps. Project developers who emerge as winners in the energy auction sign separate bilateral contracts with distribution companies in proportion to their forecast loads.

In contrast, winners of the capacity auctions receive a PPA that is socialized across all customers on the national grid. Upon securing these long-term PPAs, projects are eligible to apply for BNDES financing, as they would have passed eligibility criteria before participating in the auction.

India's power system is much more decentralized. Wind projects, for example, receive feed-in tariffs that are set by state-level regulatory commissions. Developers of such projects must negotiate one-off PPAs with power distribution companies, many of which are state-owned and in poor financial health. Once these PPAs are signed, the project must vie for funding from India's set of public and private financial institutions.

4. Case studies: summaries and project deep dives

India and Brazil face similar problems associated with financing infrastructure in rapidly developing countries, but with some crucial differences both in their economies and in their industrial and regulatory structure. The result has been models that are superficially very distinct with different objectives and benefits. However, differences at the macro level, are often much different when viewed at a more practical, day-to-day level. Thus, in this section, we focus on infrastructure investment in similar types of projects – large scale onshore wind projects – to assess how these

differences affect the finance of actual projects in a growing segment of infrastructure.

In each country we explore two wind projects each in Brazil and India, one that is typical of wind financing in that country and one that has at least one element that is unusual. Our findings are primarily drawn from extensive in-country interviews with financiers, developers, industry analysts, and civil servants. We also engaged leading multi-national development institutions to provide perspective on infrastructure financing and development issues in the global context.

Table 5. Brazilian case study projects

	Renova Energia Alto Sertão II Wind Farm (363MW)	Rio Energy Caetité Wind Farm (54MW)
Offtake	A consortium of Brazilian distribution companies signed off-take agreements	A consortium of Brazilian distribution companies signed off-take agreements
Financing	<ul style="list-style-type: none"> • Long-term debt from BNDES • Bridge loan from BNDES • Bank credit lines from Santander, Bradesco, Itaú BBA, BTG Pactual, and Citibank • Issuance of infrastructure debentures 	<ul style="list-style-type: none"> • Long-term debt from BNDES • Bridge loan from Santander • Issuance of infrastructure debentures
Status	<ul style="list-style-type: none"> • Financial closure in June 2014, when it secured \$465M, and a total cost of approximately \$717M 	<ul style="list-style-type: none"> • The project is operational with a total cost of approximately \$104M
Reasons for selection	<ul style="list-style-type: none"> • Exemplifies the role of BNDES and commercial banks in providing long-term and bridging loans 	<ul style="list-style-type: none"> • Exemplifies the role of BNDES and commercial banks in providing long-term and bridging loans • This was the first wind project in Brazil to receive non-recourse financing

Table 6. Indian case study projects

	Continuum Bothe Wind Farm (175MW)	Rio Energy Caetit� Wind Farm (54MW)
Offtake	Maharashtra State Electricity Distribution Company is the main off-taker	Madhya Pradesh Power Management Company is the main off-taker
Financing	<p>A consortium of public institutions financed the project:</p> <ul style="list-style-type: none"> • The State Bank of India led the consortium • The Indian Renewable Energy Development Agency (IREDA), and India Infrastructure Finance Corporation Limited (IIFCL) also participated 	<ul style="list-style-type: none"> • The project was financed by an IFC 'A' loan and YES Bank • YES partially sold its exposure to other financiers
Status	<ul style="list-style-type: none"> • The project achieved financial closure in November 2012, when it secured \$165M • This project is partially operational. 	<ul style="list-style-type: none"> • The project achieved financial closure in September 2014, when it secured \$150M • This project is not yet operational
Reasons for selection	<ul style="list-style-type: none"> • Illustrates the need to assemble a consortium of lenders for long term financing in India 	<ul style="list-style-type: none"> • Illustrates the need to assemble a consortium of lenders for long term financing in India • Illustrates a case where international and private financiers participated in the project

4.1 Brazilian case study analysis

Overall, we note that the policy and regulatory environment appears to play an

important role in optimizing the benefits and reducing the risks of the centralized financing model.

Table 7. Brazilian case study findings versus expected benefits and drawbacks of the stylized centralized model

	Potential	Actual
Benefits	<ul style="list-style-type: none"> Greater financial and administrative efficiency Effective contribution to multiple government policy objectives Improved liquidity in the financial system 	<p>The centralized model has not met its full potential benefits.</p> <p>While Brazil's model resulted in some areas of financial and administrative efficiency, including clear roles for commercial banks, clear eligibility criteria for developers, and access to low-cost financing, ultimately they do not appear to reduce credit risk or, ultimately, impact the overall cost of infrastructure.</p>
Drawbacks	<ul style="list-style-type: none"> Reduced public and private international investment due to crowding out Prolonged high interest rate environment Governance issues due to concentration of decision making 	<p>The low interest rates of BNDES loans may remove opportunities for international investors and for long-term lending by commercial banks, and may limit the rate of financial innovation.</p> <p>The evidence neither supports nor contradicts the contention that development banking has prolonged the high interest rate environment.</p> <p>The concentration of decision-making appears to have created the potential for governance issues and suboptimal investments.</p>

guarantees to unlock BNDES funding.¹¹

4.1.1 SYSTEM BENEFITS

Financial and administrative efficiency

The BNDES-based model achieved economies of scale and concentrated technical and financial capability. The centralized financing model created a reliable template for wind finance in Brazil (used by the Renova Energia Alto Sertão project), with BNDES providing long-term debt financing and commercial banks providing short-term bridge loans and

¹¹ In pursuing BNDES financing, a developer that has won an auction can rely on a standard template beyond its equity contribution – a template that has now been used in many national wind projects. First, a commercial or public bank provides a bridge loan. Second, a bank provides guarantees that unlock BNDES long-term financing. Third, BNDES provides long-term financing covering a fixed share of costs, with a pre-determined tenor (i.e., 16 years) and concessional interest rate (i.e., a certain share of funds is provided at a TJLP (Brazilian long-term interest rate) base rate, with a credit risk spread and administrative fee). BNDES has begun encouraging wind projects to issue debentures and has linked the proportion of funds tied to the TJLP interest rate to the issuance of these instruments.

This template for wind financing has also improved financial efficiency, by allowing commercial banks to build the technical and financial capabilities needed to assess wind projects. For example, because BNDES is averse to construction risk across sectors, banks have built capabilities to assess and accept construction risk across infrastructure classes.

The model also reduced credit risk from developers, though this benefit may be more a result of Brazil's energy auction mechanism than of the centralized financing system itself. BNDES serves as the financial foundation for Brazil's energy auctions, the eligibility requirements for which provide clear criteria that project developers must meet to be eligible for financing; this pre-clearance reduces the burden of loan due diligence.¹²

The model was supported by other regulatory and policy measures. These policies helped mitigate some risks

¹² Projects must meet eligibility requirements before they are allowed to participate in auctions. These requirements have been amended as experience highlights challenges; for example, since transmission interconnection significantly delayed past wind power projects, regulatory authorities now require wind developers to present proof that transmission infrastructure will be built by the time the generation project is ready to supply the grid. These criteria are set at the highest, national levels, ensuring policy stability. They are the responsibility of the Ministry of Mines and Energy (MME). The MME follows guidelines set by the Brazilian National Council for Energy Policy (CNPE), which includes state government representatives, energy experts, non-governmental organizations, and the President. EPE, the Brazilian Energy Research Company, decides whether a developer can participate in a given project. For example, EPE issues certification of the p50 or p90 wind resources of a given facility.

common to wind projects as in these three examples:

- Payments for wind generation from distribution companies flow into an escrow account that is used to service BNDES debt. This measure reduces the risk that the generator will use payments for a purpose other than debt service.
- Procurement contracts require actual wind generation to match promised wind generation over four year cycles. As long as generation is within 10% of the promised level, payments can be processed in the fourth year, with the generator receiving payments, reflecting the spot value of electricity¹³ for generation in excess of contracted levels. The generator will pay a penalty to the spot market for insufficient generation. If deviations within a year exceed 10%, payments to or from the generator are processed in the same year. This measure reduces wind resource risks.
- To reduce construction risks related to transmission interconnections, the regulator allows developers to participate in auctions only if they can guarantee the construction of transmission infrastructure.

The Brazilian model provided concessional debt facilities and a reduced cost of funds.

Projects financed by BNDES take advantage of its sovereign credit rating and subsequent low cost of funds. However, the lower cost of funds does not

¹³ As reflected by the Differences Settlement Price, or PLD

necessarily translate to lower overall cost, due to other risks and transaction costs that developers still have to bear, as we will discuss in following sections.

Finally, BNDES' scale supported increased debt and equity investments. BNDES's scale allows it to assume not only its conventional role as long-term financier but also encouraged bridge loans from commercial institutions. BNDES also served as a market maker for, e.g., infrastructure debentures, unsecured loans backed by general credit rather than by specified assets.

Contribution to multiple government policy objectives

Our review indicates that in recent years, the model supported Brazil's energy and industrialization goals. While this can be a benefit from a national policy standpoint, stakeholders have voiced concern over a risk of financial inefficiency that could lead to higher infrastructure costs, and a risk of governance concerns.

Brazil's NDB-based infrastructure finance model supports the nation's energy goals, through the energy auction system. The energy and reserve capacity auctions that Brazil has used since 2004¹⁴ were introduced with the goals of guaranteeing regulatory stability, ensuring the competitiveness of procured energy, and guaranteeing the availability of generation. BNDES financing was expected to provide the financial resources required for new

¹⁴ The regulatory and policy regime has been relatively stable, though there have been changes in, e.g., the availability of support from BNDES' Climate Fund Program.

generation and transmission capacity. BNDES's large participation in wind financing was not prescribed as a policy goal but rather reflects the competitiveness of wind projects in Brazil's energy auctions.

The BNDES-led financial model also facilitates Brazil's industrial policy, by including local content criteria in financing decisions. The development of manufacturing and employment bases may be the primary goal of BNDES.¹⁵ BNDES has facilitated the development of a Brazilian wind manufacturing base. For a project to be eligible for BNDES funding, it must meet the Bank's local content criteria. The Bank has guided the expansion of the sector by stipulating six milestones for local content over three years that manufacturers had to meet for their equipment to remain eligible for BNDES financing. These milestones were set in consultation with turbine manufacturing companies; in general, BNDES uses its relationships with Brazilian industry to coordinate these milestones. While the last technical milestone will bind in January 2016, wind equipment in Brazil uses ~80% local content at the time of writing.

Local content requirements are representative of BNDES's criteria in other infrastructure sectors. To access funding from FINAME, BNDES's subsidiary that finances the sales of Brazilian machinery and equipment, projects across

¹⁵ Over the last century, the Brazilian government has assumed the role of developing basic industries, with BNDES serving as an implementation partner. Indeed, Brazil's Federal Law describes BNDES as "the main instrument for the execution of the Federal Government's investment policy" (Rothmann, 2013).

infrastructure sectors generally must include at least 60% local content. While we have discussed this as part of an industrialization policy, local content criteria help limit the exposure of BNDES to foreign current exchange risk, as a large (and usually increasing) share of equipment will be domestically manufactured. Nonetheless, job creation seems to be a primary motivation for local content criteria. Earlier wind-specific auctions may have targeted wind power not only because of its previously lower cost relative to solar power but also because of the larger potential for manufacturing jobs in the wind sector than in the solar sector. Of course, decisions about which sectors to support reflect multiple stakeholders, including Brazil's energy agency (EPE), and the Brazilian Electricity Regulatory Authority (ANEEL).

It is worth noting that local content criteria can increase uncertainty about equipment availability and the costs of financing. Wind power has been dramatically successful in Brazil's recent energy auctions, but manufacturers have not expanded their capacity exactly in-line with auction results because they are concerned about policy continuity across election cycles. Project developers are therefore unsure whether the local manufacturing base will be able to meet the demand for domestic wind equipment. While developers could source equipment internationally, they will no longer be able to access BNDES funding. Even upon opting for funding from export credit agencies, currency-hedging costs would raise the cost of capital to levels commensurate with locally available commercial loans. Further, developers would have to pay import taxes that apply

when a Brazilian equivalent of the imported good is available, even if supply constraints imply that the equipment cannot really be sourced locally.

Overall, BNDES does not appear to make financing decisions so as to optimize risk-adjusted return but rather to pursue national priorities, as its proportionately large investments in power and telecoms seem to indicate.¹⁶ As a federal institution, BNDES has generally been tasked with financing areas of infrastructure that require coordination at the federal level, including several priority areas in Brazil's Logistics Investment Program¹⁷ This can be beneficial for policy goals but can also lead to inefficient financing decisions.

Maintaining liquidity in the financing system

BNDES helps maintain liquidity by releasing commercial banks' bridge loans, but the speed of disbursement and concerns about more protracted delays in financing limit these gains.

In the template of BNDES financing, long-term loans from BNDES allow for the release of short-term bridge loans from commercial banks. Nonetheless, BNDES financing has a reputation for slow processing and slow disbursement rates. Both developers and bank financiers perceive the risk of delayed disbursement to be particularly high at the time of writing, though long-term BNDES financing has

¹⁶ Between 2010-2013 investments in power and telecoms combined composed 58% of BNDES' portfolio.

¹⁷ It also reflects the countercyclical participation of BNDES during the global financial crisis. BNDES's balance sheet grew from 7.5% of GDP in 2007 to over 15% of GDP in 2011 (Park, 2012).

reliably arrived in the wind sector. The banks that provide bridge loans absorb the risk that BNDES will not provide long-term debt finance; in a few cases, banks have either extended a long-term commercial loan or taken equity in the project because BNDES loans were never extended. The perceived risk is especially high now because BNDES appears to be withholding funds from companies that are involved in Petrobras contracting scandals. Delays from BNDES extend the duration over which not only commercial money is tied to a project but also sponsors' equity; some commercial banks require equity support guarantees when providing short-term bridge loans.

4.1.2 SYSTEM DRAWBACKS

Reduced public and private international investment

International financiers have participated in (wind) infrastructure financing, but more on the equity side than on the debt side, and at relatively modest levels. BNDES loans are at rates that make international debt financiers uncompetitive and thus limit international debt financing. The concessional nature of BNDES loans limits the appetite of project developers for loans from international financiers, especially given the cost of hedging dollar- or euro-denominated loans.

While direct financing of wind projects by international financiers is uncommon, there are some examples of foreign finance in the wind sector. For instance, Enel Green Power has borrowed from international financiers for two wind projects. In one, Enel directed part of a EUR180M loan from the Danish export credit agency, EKF, towards

the 90MW Cristal Wind Farm. This decision may have reflected Enel's preference to use Danish-manufactured equipment or the temporary suspension of some manufacturers from BNDES's list of eligible manufacturers. In another, Enel has received BRL 200M from the IFC and BRL 260M from Itaú Unibanco for a wind power facility of approximately 260MW in Bahia. With its large portfolio of projects worldwide, Enel may be better positioned to hedge foreign exchange risk than other project developers.

Of course, BNDES does provide certain benefits that may help integrate international development finance by centrally assuming exchange rate risk on behalf of its borrowers. For example, KfW provided two credit lines to BNDES for wind energy financing. Such integration allows BNDES to leverage the technical assistance and environment and social evaluation mechanisms that international development finance organizations generally provide.

The model may also limit the participation of institutional investors, who could add to liquidity as well as lower cost of finance.

One reason for limited institutional participation is a low risk-adjusted return. The incremental return of infrastructure bonds may be insufficient relative to government bonds, given the incremental operational risks associated with infrastructure bonds. While these bonds pay a risk premium that is in line with benchmarks from the U.S. and UK, the spread between inflation-indexed infrastructure and Brazilian government bonds tends to be negative (Wagner et al., 2014). Another reason is that institutions

hesitate to enter a market with insufficient liquidity. Debt funds may provide the liquidity required to draw institutional funds to infrastructure investments (Wagner et al., 2014). The share of infrastructure investments among pension fund assets is currently around 2% (Wagner et al., 2014).

Innovation from commercial financiers is limited. Innovation is another important aspect for infrastructure finance models, as it can lead to continued improvements in financial system efficiency. The prominent role of BNDES in infrastructure financing limits innovation to public sector-led innovations, such as the introduction of infrastructure debentures. Overall, the centralized system may prevent the entry of new players who could contribute to financial innovation.

The terms of financing from both BNDES and commercial banks are inconsistent with “true” project finance. One are that often engenders innovation and a more rigorous approach to risk management and project structuring is project finance. By concentrating the risk and reward onto the single investment and project, investors have added incentive to innovate to fine tune the projects. In Brazil we find that the classical case of project finance without recourse to a parent company is limited. Construction financing from commercial banks is more akin to corporate finance than to project finance, as banks often require corporate guarantees Interviews suggest that some banks assess project specifics only if the creditworthiness of the parent company is not obvious. Banks have only recently started to offer non-recourse financing. Rio Energy’s Caetité project was the first non-recourse financed wind

project, with financing from Santander. The lack of project finance continues at the operational stage, as loans from BNDES include cross-default clauses that simultaneously expose the sponsor to all projects with BNDES funding. While BNDES has generally not practiced this clause, it nonetheless limits the degree to which project finance exists in Brazil. Moreover, long-term debt from BNDES relies on commercial or bank guarantees; in some instances, these guarantees themselves require equity support guarantees from parent companies.

While concessional debt can reduce the financing cost of wind projects, the overall cost of infrastructure may not be reduced, given (a) the cost of bridging the TJLP (Brazilian long-term interest rate) and SELIC (short-term interest rate) and (b) the apparent lack of cost-benefit analyses guiding each loan decision. While the standard terms of BNDES financing and availability to all winners of wind projects provide developers and bankers with certainty, the uniform terms of BNDES financing suggests that financing decisions optimize neither risk-adjusted return nor social welfare. Before disbursing a long-term loan, BNDES requires evidence of a debt service coverage ratio of 1.2 (for an 80% share of financing) to 1.3 (for a 70% share of financing), regardless of the project’s location and the project’s options to mitigate its operational risks.

The lack of customization of the debt service coverage ratio (DSCR) may imply too much or too little risk taking by BNDES. Similarly, it is unclear if every project that wins energy or reserve auctions requires BNDES financing to remain economically viable. Finally, because BNDES generally cannot coordinate investments in

generation and transmission capacity, as these plans are defined by the schedule of auctions, BNDES's concessional loans imply a large cost to the federal government, as it must fund the difference between the TJLP loaning rate and SELIC, its benchmark interest rate.

Box 2. Infrastructure debentures in Brazil

Recognizing the cost of providing debt finance to virtually all wind projects in Brazil, BNDES seeks to decrease its share of financing of wind projects from 70% by encouraging developers to issue debentures – unsecured loan certificates backed by general credit rather than specific assets. While the share of BNDES financing would fall for a project issuing debentures, changes in the BNDES debt repayment schedule allow the developer to achieve greater leverage. In particular, developers that finance 10 – 15% of their project costs via debenture debt can use the French amortization system (Price) to amortize their BNDES loans, instead of the constant amortization system (SAC, in Portuguese). Since the Price system has fixed installments instead of the SAC's decreasing installments, this change allows projects to service debt, even at a higher leverage ratio.

Through 2014, infrastructure debentures accounted for less than 0.5% of the Brazilian debt securities market, and their effectiveness remains to be seen (Wagner et al., 2014). In addition to their leverage benefits, five factors may facilitate the uptake of debentures. First, complimentary debentures enjoy equal seniority along with the BNDES loan and share all project guarantees with the BNDES loan. Second, lower taxes on personal income and foreign investors should attract such investors. The income tax provisions have been particularly powerful, as individuals account for 42% of debenture holdings (SEM, 2015). The diffuse holding of debentures by many individuals has encouraged the emergence of a secondary market for debentures. Third, cross-default clauses make debentures safer for investors, as they would have access to assets of all projects sponsored by the issuing company. Fourth, the terms of debentures include inflation indexation. As Wagner et al. (2014) indicate, such adjustments may not offer adequate protection to investors in medium- and long-term infrastructure bonds. Instability in the regulatory structure, i.e., that related to price adjustment methodologies, a disconnect between realized costs and chosen cost indices, an exposure to quality-related penalties, and the feasibility of price increases for concessions, may increase the risk embedded in bonds. Fifth and finally, BNDES established a liquidity line in August 2015 to guarantee debt servicing in the bond market, the Credit Line to Support Liquidity (LSL). The LSL will function as standby credit to investors in infrastructure debentures (Veirano Advogados, 2015). At the time of writing, no projects were using the LSL.

Notwithstanding these benefits, developers are uncertain about the net benefits of debenture issuance. Upon using debentures, developers cannot project the level of leverage they will be able to achieve. The poor performance of a small set of (wind) infrastructure debentures could limit the appetite for all (wind) infrastructure debentures. Moreover, the small volume of the debenture market contributes to uncertainty about the market's demand for a particular instrument at the time of issuance. This risk increases the equity contribution required of developers. Further, while the low BNDES reserve account requirements for underlying long-term financing may encourage a greater issuance, it may limit their credit ratings.

Prolonged high interest rate environment

While our current analysis cannot determine whether the high interest rate environment in Brazil is due to “too much” NDB borrowing or is the happy result of higher labor and capital utilization as a result of NDB intervention, we note that Brazil’s benchmark interest rate is higher than that of other sizable upper-middle-income countries with similar growth rates and inflation rates.

Table 8 compares Brazil’s benchmark rate against peers with the most similar growth and inflation rates. The “distance” reflects the root of the sum of the squared differences between the country’s growth and inflation rates, relative to Brazil’s. The lower the ranking, the closer the country’s growth and inflation rates to Brazil’s. We do not present data for countries with small economies.

Table 8. Comparison of Brazil’s benchmark interest rate against peers

Country	"Distance" ranking	Avg. growth rate, 2010-14	Avg. inflation rate, 2010-14	Interest rate
Brazil	1	3.2	7.2	14.25%
South Africa	5	2.4	6.1	6.00%
Turkey	8	5.4	7.2	7.50%
Ecuador	11	5.0	4.7	8.06%
Iraq	13	6.1	8.6	6.00%
Romania	16	1.4	4.4	1.75%
Mexico	18	3.3	3.7	3.00%
Colombia	21	4.8	3.5	4.50%
Peru	22	5.8	3.6	3.50%
Kazakhstan	25	6.0	11.0	12.00%

Excessive concentration of decision making

There are significant areas of financial and administrative inefficiency not addressed by the model, impacting interest rates or transaction costs that raise the overall cost of infrastructure. For instance, BNDES limits its risk-taking by avoiding construction risks. Therefore, developers face the transaction costs of building a consortium of banks willing to provide (1) a bridge loan to cover the construction phase before BNDES provides long-term financing and (2) guarantees or letters of credit required for BNDES to disburse its long-term financing. In rare cases, BNDES will itself provide the bridge loan and, in some thermal projects, the equipment manufacturer will provide it. In general, however, the project sponsor and bridge financier bear construction risks. Because of the positive track record of such projects and the shorter duration of construction relative to other sectors, letters of credit for wind projects have tended to be less costly than letters for other sectors. Nonetheless, certain banks are reaching limits for their exposure to wind construction risk. This could reduce the competitiveness of the construction financing market. Rates for bridge financing, which have traditionally been around 15%, had recently increased at the time of writing to ~20 – 22% (though we also note that this could be the result of higher labor and capital utilization as a result of BNDES intervention).

Another unaddressed and important risk is that of transmission interconnection delay, which used to fall on distribution companies and is now addressed by developers. Past contracts included a clause that generators would receive payments from

distribution companies regardless of whether wind farms were connected to the transmission network. If distribution companies did not oblige, they would not be eligible for tariff adjustments by the regulator. Notwithstanding this threat, the ultimate burden of payments for non-existent power rested with consumers, who directly paid for this unproduced power on their electricity bills.

The burden of transmission interconnection risk on the developer is new, and it is unclear if interconnection will now happen more smoothly. The difficulty of transmission interconnection reflects two challenges. First, the environmental permitting process is a long one; anecdotal evidence suggests that delays in processing cause the majority of transmission lines to be added after the deadline stipulated by the concession. Second, a revenue cap has rendered investments less attractive. A recent increase in this cap was insufficient to attract private investors.

Generally, the ability to support multiple objectives can become a negative if those policy objectives are counterproductive or populist. They can also lead to overinvestment in one sector at expense of others, due to policy goals. The majority of recent investments have been made in electric power (33.4%) and telecoms (24.5%) while other infrastructure classes like ports (5.2%) and rail (10.6%) have been comparatively underweighted.¹⁸ Another criticism of BNDES is that much of its financing goes to large companies, like

¹⁸ Investments from 2010-2013.
http://www.bndes.gov.br/SiteBNDES/export/sites/default/bndes_en/Galerias/Download/insight77.pdf

retailer Lojas Americanas and brewer Ambev, which arguably could have accessed funding from other sources.¹⁹

When several of the potential negative consequences of concentrated decision making were tested with BNDES investment data between 2002 and 2009 findings indicated that BNDES loans and equity investments did not affect firm-level performance or investment but instead reduced financial expenditures. On the other hand, BNDES did not lend to poorly performing firms but instead subsidized firms that could have funded their projects with other sources of capital.²⁰ These findings suggest that NDB-led models need to include safeguards to prevent NDBs from growing too large and making “unnecessary” investments that do not enhance social welfare.

The excessive concentration of decision making is not as large as it may seem.

State and regional financial development institutions tend to finance state- and municipal infrastructure without federal-level coordination issues. As with BNDES, sub-national institutions are experienced in supporting small and medium-sized enterprises. Nonetheless, they have been mandated with financing, for example, regional airports, municipal transport systems, and water and sanitation projects. These institutions tend to lack some of the advantages of BNDES. For example, they may not have access to the same set of

¹⁹ Leahy, Joe (2015). "BNDES: Lender of first resort for Brazil's tycoons." *Financial Times*. January 11, 2015. Accessed December 5, 2015.

²⁰ Lazzarini et al., 2015

international development financiers, as some require their partners to have guarantees from the central government. The process of obtaining these guarantees is difficult and may limit the partnership of some international development financiers to BNDES. Similarly, sub-national banks may not be able to hedge foreign exchange risks as cheaply as BNDES. Notwithstanding these limitations, sub-national institutions have access to public funding, and some international development banks and financiers (e.g., IDB and IFC) are beginning to work more closely at the sub-national level. While state financial development institutions were officially set up only in the 1990s and thus have less clear track records than BNDES, they may be able to follow some of the strategies of BNDES to direct capital towards sub-federal scale infrastructure projects. For example, by announcing large energy auctions or simultaneously releasing multiple transportation concessions, the federal government and BNDES provide the scale necessary to attract private sponsors and financiers to participate in infrastructure development. State- and regional-level institutions could aggregate projects (e.g., announce simultaneously the financing of 5 – 10 municipalities' water and sanitation systems) so as to achieve similar scale effects.

4.1.3 OUTLOOK AND POTENTIAL IMPROVEMENTS TO COMPLEMENTARY POLICY

Current macroeconomic and political trends in Brazil are increasing financing costs. The Brazilian government has increased TJLP by about 200 basis points in 2015. Bridge loan and letter of credit terms have also increased to reflect greater

perceived risks, reflecting uncertainty about debt servicing by large construction firms that were involved in corruption.

Delinquency on these loans would limit the availability for new construction financing. Banks may nonetheless continue to lend to the wind sector, as developers tend to be well-known companies without stated-owned involvement. Moreover, the transparency of auctions reduces the room for corruption in the renewable energy space.

Overall, our analysis suggests that complementary policies can help optimize the benefits associated with this model, and reduce the risks. The following are some potential areas for improving the model.

A structure in which BNDES finances only those projects that provide large social benefits and require BNDES funding for economic viability, could better leverage BNDES's access to low-cost capital.

In addition, this could allow BNDES to leverage its scale across wind projects and deepen its risk taking across different stages of project development. While BNDES's scale implies an exposure to a range of operational risks, BNDES may be able to offer greater support by taking a mix of operational and construction risks.

The introduction of guarantee instruments that could allocate construction risks easily could encourage more project finance.

Since BNDES is reluctant to take construction risks, and commercial banks have a limited capacity to accept construction risks, BNDES is working with insurance companies to issue completion bonds; these would reduce construction risk

and the cost of construction finance. Developers are hesitant to use such instruments because the terms of insurance may allow insurers to avoid payment. The World Bank is also developing new instruments; one, a new Project Bond, is intended to attract financing from the capital market. The Bond includes guarantees either at the end of the construction period or at maturity.

In addition, the Brazilian government has created a state-owned company called the Brazilian Management Agency of Funds and Guarantees (ABGF) with an initial capital stock of BRL 50M. Its role will be to provide guarantees for large infrastructure concession projects. ABGF will develop the guarantees demanded by the market. The main demand for ABGF is for credit guarantees for concessions of highways and railways (Wagner et al., 2014). ABGF is projected to implement guarantee funds to cover uninsurable risks, such as those related to regulatory changes and Acts of God. ABGF would operate where the insurance sector is not providing coverage or in places where the insurance sector invites them to participate; in the latter case, ABGF would restrict its participation to 20% coverage.

Even with these instruments, the Brazilian infrastructure sector will remain challenged by lengthy bankruptcy processes and, outside of the power sector, regulatory uncertainty. For example, the World Bank estimated that water companies in Brazil have a regulatory risk premium of 5%, due to the uncertainty around future concessions.

Easing regulatory restrictions on the proceeds from re-financing could support a re-financing market and further enhance liquidity.

The re-financing market is virtually non-existent in Brazil. The refinancing by Isolux of transmission lines is a rare example. Isolux had planned to invest in new transmission lines, so the regulatory restrictions associated with refinancing did not constrain its plans.

Four modifications can assist the development of wind infrastructure in Brazil.

The first would change the maximum farm size for which tax incentives are available, would decrease the transaction costs associated with financing. Now, only wind farms under 30MW in size are eligible for tax incentives, compelling developers to finance separately multiple farms of under 30MW in size. The second would stagger the start date of wind farms that win contracts. Currently, all wind farms that win a given auction must begin operating on the same date, straining the supply chain. The third would be to focus BNDES financing on the wind sector, instead of allowing it to assume a broad financing role. The final would be to introduce dollar-linked PPAs, especially since a number of large Brazilian customers sell dollar-denominated products (e.g., iron ore, oil and gas).

Clear definition of accompanying regulatory and policy frameworks can support the model's effectiveness in other sectors.

Despite the limitations in financial and administrative efficiency, the potential crowding out of other lenders, the concentration of decision-making, and the low level of innovation, the BNDES-led wind financing model has succeeded in

facilitating the implementation of wind projects in Brazil. The model has not been as successful in other infrastructure sectors. Intuitively, financing is more difficult for sectors with (1) longer terms of financing, (2) histories of revenue problems (e.g., sugarcane or gas, with supply problems), and (3) required environmental licenses, given slow permitting processes.

Moreover, the lower transparency and reliability of the regulatory structure surrounding other sectors may limit the success of infrastructure development with BNDES financing. While the auction system introduced regulatory and policy discipline in the energy sector, the terms of concessions for, e.g., railroads, airports, and ports may not be as robust. In the railroad sector, for example, remuneration may not be in line with the costs and risks of construction. Of six new lines totaling 4676km in the government's logistics infrastructure program, none are under construction. This status is attributed to project failures, work errors, and delays in environmental permits (Smith, 2015). Further, the implementation and functioning of the envisioned open-access freight model are not well understood. Multiple operators would bid for paths on the same route, with construction carried out by private concessionaries who operate and maintain infrastructure. Valec, a federal agency, would be responsible for purchasing and redistributing lines to private rail freight operators, with individual operator able to purchase up to 30% of a single line. The lack of operational experience and risk of regulatory changes appears to have limited the demand for BNDES financing and the realization of infrastructure goals.

4.2 Indian Case Study Analysis

India, where there is no monolithic development bank, but rather a collection of state owned banks, domestic commercial banks and international banks, is an interesting contrast to the BNDES led Brazil. Many of the domestic banks are

descended from national development banks that were converted to more commercial organizations at the behest of the government, but continue to take a development role, albeit on commercial terms. As in Brazil, we focus on the financing of two wind energy infrastructure projects to provide a fair comparison.

Table 9. Indian case study findings versus expected benefits and drawbacks of the stylized decentralized model

	Potential	Actual
Benefits	<ul style="list-style-type: none"> • Greater financial innovation • Increased participation by more financial institutions and private investors • Reduced government interference and other governance issues • Smoother integration of international development finance 	<p>The model has not resulted in significant financial innovation, although there is some evidence that that is gradually changing.</p> <p>While more investors participate in infrastructure finance, many of them have been state owned, so the diversity may not be as great as it seems.</p> <p>It is unclear whether the level of government interference is a function of the financing structure.</p> <p>International development finance plays a stronger role in India and this is often funneled through specific projects, as well as India government institutions. However, the greater presence may just reflect the greater need in India.</p>
Drawbacks	<ul style="list-style-type: none"> • Higher cost to the system • Uneven investment with shortages in some key sectors • Restricted use of pure project finance models • Reduced leverage of projects leading to increased risk seeking by investors 	<p>The system had been relatively high cost, and there have been examples of high administrative costs affecting projects.</p> <p>In general, we have found evidence for each of drawbacks seems likely in the Indian context.</p>

Financial innovation

Though there are many players in the financing landscape, the level of innovation to improve financial efficiency is low. Most finance is in the form of plain vanilla term loans. Members of lending consortia accept the terms negotiated by the lead financier, implying that loans are not amended to meet the liabilities of each participant. Debtors also do not attempt to modify terms from each creditor, limiting their ability to customize terms to their cash flow needs. In some cases (e.g., solar projects), the standard timeline to commission solar plants (i.e., 13 months) removes opportunities to amend financing terms with lenders.

Over time, the greater number of institutions in India may allow the Indian market to experiment with more products and over a shorter time period than could the bank-led model in Brazil. Multiple institutions within the Indian financing landscape are currently introducing innovations. This may attest to a greater innovative capacity within decentralized infrastructure financing models. Some developers are pursuing limited refinancing opportunities and hope to achieve a 100 – 150 basis point reduction in the cost of capital. IREDA has proposed to develop refinancing lines (IREDA, 2014). YES Bank has floated a \$160 million green bond, with the intent to use these funds to refinance at loans at the cost of ~10%. IIFCL has introduced partial credit guarantees to the market, and it is considering introducing completion guarantees.

Participation by more financial institutions and private investors

Even in the absence of a national development bank in India, the public sector leads the financing of infrastructure from a diverse set of investors. Five classes of institutions directly finance infrastructure: (1) public financial institutions (e.g., IREDA, IIFCL, PFC, and REC), (2) public banks (e.g., SBI), (3) private banks (e.g., YES Bank), (4) private financial institutions (e.g., IDFC, ITCL), and (5) international development financiers (e.g., IFC).²¹

Despite this diversity, public financial institutions and banks provide the bulk of infrastructure finance. For example, while about 20 banks are providing loan financing for renewable energy projects, the bulk of these are public banks (e.g., SBI, Punjab National Bank, Andhra Bank, and the Central Bank of India). The two India analyzed in this report illustrate this point. One project is financed wholly by the public sector; though the other is partially financed by a private bank, public players form part of the lending consortium. Public finance has not displaced private finance, as private banks are hesitant to finance renewable energy projects.

These participants in wind financing lend because of mandates or unique risk mitigation strategies. Public- and international development financiers are

²¹ IREDA: Indian Renewable Energy Development Agency, IIFCL: India Infrastructure Finance Corporation Ltd., PFC: Power Finance Corporation, REC: Rural Electrification Corporation, SBI: State Bank of India, ITCL: IL&FS Trust Company Ltd., CLP: China Light and Power, LIC: Life Insurance Corporation of India, PTC: Power Trading Corporation.

lending because of a mandate to do so and/or a belief that their influence on public-sector off-takers and the government provides them some protection from the risk of non-payment. Some international organizations have financed wind projects only after considering the debt service potential of projects in the case of discom delinquency. In addition to examining the schedule of tariff hikes planned by the discom and overseeing regulatory commission, financiers have analyzed the health of the state balance sheet, as the state government would bail out the discom, in case of insolvency. Moreover, financiers have assessed whether the wind facility could sell power through the open access mechanism by which a generator can sell directly to a large customer. An advantage of open access is the ability to negotiate a tariff that is higher than that from the utility PPA but lower than the retail rate charged by the utility. However, the utility has no incentive to allow open access, as it implies a loss of revenue from its best paying customers.

While new entrants could develop innovations, the entry of financial institutions has been regulated and limited. For example, between 2004 and 2014, India provided a banking license to only one bank, YES Bank. Regulatory bodies (e.g., the Reserve Bank of India) have also carefully regulated the practices of existing institutions. IIFCL was only recently allowed to provide partial credit guarantees to enhance the credit rating of infrastructure bonds.

YES Bank, which provided a 17-year loan with a variable interest rate to the

Continuum Madhya Pradesh Wind Farm, may be an exception among private banks; as a young bank, it perceived renewable energy as an opportunity to build a unique selling proposition. Its more sophisticated risk management system may have allowed it greater comfort with the risk profile of renewable energy projects than other banks have displayed.

Reduced government interference and other governance issues

The diversity of financiers offers a reduced risk of government interference. India dismantled its national development bank framework starting in the mid-1990s, partially due to concerns about corruption. By 2011-12, assistance disbursed by the DFIs amounted to just 3.2 per cent of Gross Capital Formation.

While the decentralized nature of public institutions can reduce the potential for governmental interference, several institutional traits can still prompt suboptimal investments. The continued bailouts of public-sector power off-takers that are in poor financial health likely creates a moral hazard in project selection; indeed, some public financial institutions are required to lend to projects in states with the worst performing discoms. Further, though there are many public financial organizations with a focus on the power sector, the distribution of board seats among members of the Ministry of Power implies that the Ministry can influence investment decision-making. The boards of PFC and REC include representation from the Ministry of Power, with the same representative from the Ministry serving on both boards. Such

coordination can permit the pursuit of either socially beneficial or costly programs.

Similarly, in some public financial institutions, all loans ultimately have to be approved by the chief managing director (CMD). In addition, the sourcing of projects is contact-driven, with relations with the CMD considered to be an important driver of financing decisions. The centralization of decision-making within organizations can make it easier for borrowers to influence the decision-making process, and appropriate financial incentives, such as performance-linked bonuses, may not be in place to ensure effective counters.

Moreover, links between public financial institutions and governmental ministries may push financiers to make uneconomic investments. Three examples illustrate this

potential. First, public financial institutions may be mandated to favor projects in states in which the distribution company is in poor economic health, as no other financier would be willing to finance projects there. Second, public financial institutions may be directed to support central government goals that offer low or negative returns (i.e., the PFC financed the 2012 Financial Restructuring Plan of the Ministry of Power). Three, financing may have sometimes been provided without adequately considering the risks of obtaining environmental clearances, fuel supply disruptions, and willingness of discoms to buy power. These gaps in the diligence process may help explain why a large number of loans to independent power producers have been restructured to avoid labeling them as non-performing assets.

Box 3: *Limited private finance in Indian power sector: Focus on Banks and Institutional Investors*

The poor health of off-takers in the power sector (i.e., distribution companies) and other perceived revenue risks have limited the appetite for power financing by the private sector.

In most cases, wind PPAs are signed with fiscally fragile public off-takers (i.e., distribution companies or discoms). This fragility stems from large distribution-level power losses and sales of power at a price lower than procurement costs. Their poor health raises at least three revenue risk concerns among financiers. First, discoms are occasionally requesting renewable generators to curtail; they would rather shed load than buy more power and pay rates higher than the tariffs they can charge. Second, payments from discoms are often delayed, with the generator having no practical recourse for these delays. Though some PPAs include a formal statement about interest payments on delayed payments, in practice, no independent power producers receive these interest payments. Some developers have suggested that the only way to expedite payments is to provide bribes. Third, the cost trajectory in the solar sector has prompted concerns that discoms will simply refuse to pay PPAs, given the availability of lower solar prices.

In addition to these concerns about the stability of payments from off-takers, perceived revenue risks in Indian projects originate in the variable quality of wind resource assessments

and experiences with underproduction. Equivocal policy support also signals a lack of commitment from the central government. The Renewable Portfolio Obligation (RPO)/Renewable Energy Certificate (REC) program was supposed to provide renewable energy projects with additional revenues, but lax enforcement by state-level regulators yielded RECs of zero value. Similarly, the reversal of accelerated depreciation provisions for wind investments signaled a lack of policy continuity. Finally, Generation Based Incentive (GBI) payments are generally delayed by 1 – 2 years. While the magnitude of these payments is sufficiently small that financiers are not particularly concerned about delays, they signal an uncoordinated policy process.

Given that banks cannot easily exit financing agreements, private banks have been reluctant to enter the space; indeed, the only option available to banks in case of poor payment performance is to restructure loans.

Institutional investors, too have had limited participation in infrastructure investment. They are exposed indirectly to renewable energy by the purchase of bonds from organizations that directly finance such projects. While institutional investors are interested in increasing their exposure to renewable energy, the small size of projects to date, relatively low credit ratings of projects, and regulatory stipulations limit their participation. CPI analysis indicates that institutional investors are restricted to investing in projects above a certain credit rating threshold, which is AA or above in the case of India. Most renewable energy projects fall below this threshold.²² Domestic institutional investors may not require an illiquidity discount, as they tend to hold notes until maturity, given the nature of their liabilities.

Even insurance companies, which are required to invest 15% of their assets in infrastructure, have limited their participation to ~11% due to the low creditworthiness of infrastructure projects, lack of opportunities to invest indirectly, and small sizes of projects. The Indian insurance regulator requires Indian insurance companies (as with other institutional investors) to invest only in projects with a domestic credit rating of at least AA. Moreover, Life Insurance Corporation of India (LIC), which has a roughly 70% market share of the Indian insurance market, can only invest in the debt of public limited companies and take equity positions in actively listed shares. LIC has been unable to reach its 15% target. 60% of LIC's investments are in bonds, with the balance in term loans. The bulk of LIC's bonds expose the insurance company to the power sector (e.g., through holdings in PFC, REC), which provides it with indirect exposure to renewable energy, or to state governments, who handle investments in various other infrastructure sectors. LIC's only direct exposure to renewable energy is in manufacturing and project development, through its investment in Suzlon. One of the barriers to LIC's participation in renewable energy financing in India is the small size of available investments as LIC prefers to make investments of at least INR 1B (~\$16M at 1USD = 60INR).

²² <http://climatepolicyinitiative.org/2015/10/08/institutional-investors-can-help-india-meet-its-climate-action-pledge/>

Restrictions on the maximum share of equity and debt that LIC can hold imply that projects must be much larger than INR 1B in size.

LIC's investments are of limited liquidity, but the corporation does not perceive a downside to illiquidity. LIC generally purchases bonds through private placements. These placements provide debt of relatively long tenor (i.e., at least 10 years) and of greater magnitude than many debtors could otherwise access from a single investor. Given its unique role in the bond landscape, LIC can charge a premium on the market interest rate for smaller investments. Nonetheless, LIC does not tend to ask debtors to structure debt instruments to meet the Corporation's specific needs. LIC generally holds bonds to maturity, given the lack of a resale market. Given LIC's long-term liabilities, LIC also does not feel a need to trade bonds. This relative disinterest may stem from a 12% tax on LIC's surplus above its coverage of liabilities.

In addition, a lack of listed assets and funds for indirect exposure may limit the participation of LIC in renewable energy financing. LIC does not have a dedicated team with which to assess opportunities for direct investment in renewable energy projects, and this likely restricts their participation. While LIC is willing to increase its exposure to renewable energy, it prefers an indirect exposure. Investment vehicles, such as funds of projects, may help increase the participation of LIC in renewable energy financing. Given the regulatory restrictions on LIC to invest in the debt of public limited companies, a fund that specifically focuses on infrastructure projects with public sponsors may be especially helpful. Similarly, LIC's term loans tend not to be of investment grade, preventing the transfer of LIC's exposure to borrowers. As with its purchase of bonds, LIC does not generally alter the structure of term loans; instead, it usually joins a consortium of lenders, with the lead lender performing all appraisal and setting all terms.

Integration of international development finance

Multiple entry channels facilitate the deployment of international development capital. International development finance flows to India in 2014 was \$2.3 billion, compared to \$1.2 billion to Brazil. The presence of BNDES may be discouraging the flow of international DFI money into Brazil, compared to India.²³ Development financiers seek to mobilize domestic public-

and private-sector funders. Some development financiers have prioritized renewable energy financing because they can provide expertise that they have gained in other geographies, including their home countries. Development financiers often rely on public institutions to disburse their development capital; while this preference for lending via partnerships with public-sector domestic institutions is not peculiar to India, partnerships with multiple public-sector financial institutions allows development financiers to diversify their exposure to institutional risks in India.

International development financiers actively influence the activities of their

²³ Climate Policy Initiative (2015). Global Landscape of Climate Finance 2015. <http://climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2015/>

partners. For example, KFW encouraged REC to finance renewable energy, and due diligence by IFC is likely to have motivated SBI to purchase a loan for the Continuum Bothe Wind Farm. The funneling of development finance through local institutions may increase the uptake of development finance, as developers generally perceive development capital to be just as expensive as local, commercially available capital, once hedging costs and social and environmental compliance costs are included.

4.2.2 SYSTEM DRAWBACKS

Cost to the system

The benefits of Indian public infrastructure financing are limited by non-concessional terms and transaction costs of forming consortia of lenders. Public financiers provide capital at commercial rates and tenors, limiting the leverage of their funds in infrastructure financing. The inability of even dedicated institutions (e.g., PFC, REC, IREDA) to offer concessional terms may reflect the risks of their single-sector exposure and a level of illiquidity that exposes them to all defaults and removes opportunities for them to re-invest their funds elsewhere. Moreover, regulatory limitations on the exposure of public organizations to projects, the renewable energy class, and the power sector constrain the size of loans from public institutions. Even with some private-sector bank involvement, developers bear the transaction costs of forming consortia of lenders. Among other factors increasing these transaction costs are non-standardized documentation requirements across lenders.

While IREDA was among the first financiers of wind power in India, it has built a reputation for being “more commercial than even the conventional commercial” lenders. While it accesses funds from, e.g., KFW at a cost of, e.g., 2%, it lends on commercial terms; as we mention above, this may reflect its single-sector exposure. Nonetheless, the perception is that IREDA was a hesitant participant in solar financing, given concerns that the tariffs bid were too low; moreover, developers perceive IREDA as providing loans of shorter tenor. The Continuum Bothe project illustrates the commercial character of IREDA’s loan; financiers believe that another private- or public-sector institution would have taken IREDA’s place in the funding consortium, given the loan’s commercial terms.

Finally, the variable interest rates common in Indian renewable energy financing increase the project’s risk profiles. The cost of equity in India is approximately 350 basis points higher than those in the U.S. and Europe (E&Y, 2014); this premium may partly reflect the greater risks of a variable interest rate environment.

The high cost of administering the system has not been offset by cost efficiency from innovation. With limited innovation, the cost of debt remains high. Plain vanilla loans allocate almost all project risks to developers and debt financiers. Though off-takers may formally assume some risk in projects, in practice (as in the Continuum projects studied) they do not. For example, while PPAs include provisions for interest payments by off-takers on delayed payments or letters of credit from off-takers to support projects’ debt financing, such

payments and letters are neither expected nor delivered in practice. Similarly, the practical level of risk borne by equity investors can be smaller than at first expected, as conglomerate sponsors can award EPC contracts to their subsidiaries and “cash out” regardless of project outcome.

Uneven investment with shortages in some key sectors

Only some infrastructure sectors have access to (often high-cost) capital.

Specifically, current institutions ensure that the power, road, and rail sectors have reasonable access to capital with either dedicated public financing institutions (power), direct access to revenues (road and rail), or the ability to raise money through bond issuances (power, road, and rail). Other sectors (e.g., ports, education, and healthcare) lack similar access.

Restricted use of pure project finance models

Project finance is limited in India, with financing based at least partially on relationships and balance sheets of parent companies, rather than individual project merits. The classic case of project finance is where a project can borrow strictly on the merits of the project with no recourse to the parent company. This enables innovation and can also help developers finance good projects, even if the developer would otherwise be too small for the project. In practice, new developers in India find it difficult to raise capital. Some public financial institutions explicitly consider a mix of corporate-level and project-level attributes when setting the terms of

financing. Before raising its latest and largest rounds, Continuum, the developer of both of the projects we examine in depth, was able to raise finance because it had already developed small-scale (<35MW) projects. It was also partly owned by Morgan Stanley Infrastructure Partners.

Reduced leverage of projects leading to increased risk-seeking by investors

Lower differentials between equity and debt costs limit the advantages of leverage.

The high cost of debt likely reflects the low levels of financial innovation. Projects in India generally adhere to a 70:30 debt to equity ratio, implying a lower level of leverage than observed globally. This is likely to increase risk taking.

4.2.3 OUTLOOK AND POTENTIAL IMPROVEMENTS TO COMPLEMENTARY POLICY

Despite India's high savings rate (~32%),²⁴ the limited tenor of bank loans and participation of domestic institutional investors has limited the flow of funds to infrastructure.²⁵ Yet in order to achieve India's renewable energy targets of 175 GW of solar and wind power by 2022, India is seeking approximately USD 100 billion of investment in renewable energy

²⁴ World Bank (2015), indicator NY.GNS/TOTL.ZS; note that Brazil's rate is approximately 17%.

²⁵ Institutional investors are exposed indirectly to renewable energy by the purchase of bonds from organizations that directly finance such projects. While institutional investors are interested in increasing their exposure to renewable energy, the small size of projects to date, relatively low credit ratings of projects, and regulatory stipulations limit their participation. Domestic institutional investors may not require an illiquidity discount, as they tend to hold notes until maturity, given the nature of their liabilities.

infrastructure over the next few years,²⁶ including USD 70 billion of debt. Another key challenge facing India is the high cost of financing, which raises the cost of renewable energy by up to a third compared to similar projects in the U.S. and Europe.²⁷

As in the Brazilian centralized financing model, policy and regulation can optimize the benefits and reduce the risks of the decentralized model. Our analysis suggests the following:

Several innovations could lower the cost of renewable energy financing in India. The appropriate risks for the public sector to absorb reflects the nature of public involvement in the sector, as this affects the areas in which it is better informed and able to manage risks. Given the public ownership of most large power distribution and transmission companies, the public sector may be better suited to absorb (1) off-take risks,²⁸ (2) inter-connection and construction risks,²⁹ and (3) payment delay

²⁶ <http://cleantechnica.com/2014/11/09/india-eyes-100-billion-investment-renewable-energy/>

²⁷ Climate Policy Initiative (2012). <http://climatepolicyinitiative.org/publication/meeting-indias-renewable-energy-targets-the-financing-challenge/>

²⁸ Off-take risks entail adjustments to the seniority of payments to power producers. Some developers reported that the usual order is for private power producers to be paid first, with central-level public power producers second and state-level public power producers third. Since discoms tend to be publicly owned, governments may have the required leverage to prevent changes in this order of payments.

²⁹ Given public ownership of some transmission infrastructure, the government may also be able to

risks,³⁰ as it is better informed about these risks and better able to manage them than is the private sector. In both of the projects that we study in depth, these risks remain with the developer and financiers. An allocation of these risks to the public sector may reduce the financing costs of renewable energy projects.

Other potential innovations³¹ include (a) central foreign exchange hedging facilities, (b) construction finance facilities, and (c) a large-scale re-financing market.

A central hedging facility could reduce the overall costs of hedging foreign exchange risks. The individual public financial institutions may be too small in scale to absorb foreign exchange risk. Several stakeholders suggested two additional ways by which to reduce foreign exchange risk-related financing costs. One method involves dollar-denominated PPAs. Since most off-takers are public and backed by the state and central governments, this would shift currency-related risks to state and central governments. While this may reduce hedging costs, if the government were to operate a central hedging facility, it is unclear whether it is currently better suited to assume these risks. Dollar-based PPAs have tended to work in locations with explicit pegs to hard currencies. The other approach would be to allow the

provide guarantees about the timing of connection to the transmission network.

³⁰ An enforcement of existing penalties on late PPA payments could reduce the risk of payment delays.

³¹ This list is not exhaustive. Examples of innovations not listed here include revolving credit facilities and debt exchange mechanisms.

international issuance of rupee-denominated bonds, thereby shifting risks to international investors. This assumes that non-Indian investors would have a lower cost of absorbing foreign exchange risk. While offshore hedging rates have been lower than onshore hedging rates (e.g., 6.35% for a three month off-shore hedge in April 2015 versus 8% for an onshore hedge), it is unclear whether that spread will characterize future differences (Iyer, 2015).

A construction finance facility would help separate construction and operational risks

and offer a step-down in financing costs after the project demonstrates its debt servicing potential. Currently, loans tend to charge a rate that reflects the average of construction and operational risks. Once a project becomes operational, lenders do not have an incentive to reduce the interest rates to reflect the lower risk profile of the project. A Rupee-denominated revolving credit facility could provide short-term loans and allow developers to reduce their hedging requirements.

Public financiers may be able to achieve greater leverage by providing indirect financial support. For example, IREDA could prime the refinancing market by providing **concessional rates for refinancing.** It has proposed to use the National Clean Energy Fund (NCEF), which is raised from a charge on coal mined in or imported by India, to do so. Refinancing would not exceed 30% of the original loan (IREDA, 2014). The rate of interest from IREDA would be 2%, with a limit on the refinancing rate of 5% (IREDA, 2014). Only loans originating after FY2013 – 2014 would be eligible for the program, and IREDA would require repayment within 10 years (IREDA, 2014). Initiatives such as these would increase the liquidity for investors, free bank debt, reduce the cash drag on investments, and reduce the cost of financing infrastructure. Refinancing is particularly important in the Indian context, where loans carry rates of 12 – 16%. The partial credit guarantee is a recent example of indirect financial support that public financial institutions can provide (see Box).

Box 4: Partial Credit Guarantees

The **partial credit guarantee (PCG)** recently offered by IIFCL in the ReNew Power bond issuance is a clear example of the types of indirect financial support that public financial institutions could provide. This INR 4.5B (USD 75M at 1USD = 60INR) bond was the first to make use of this instrument and secured a 9.75% fixed interest rate, with a 75:25 debt to equity ratio. The long tenor likely reflects the two-notch enhancement (from A to AA+) delivered by the first-loss credit guarantee of 26% of the outstanding debt for the first two years and 28% thereafter. The PCG is structured such that IIFCL ranks *pari passu* in liquidation but in the cash flow waterfall would be paid back only when the project has a positive cash flow, net of its senior debt service. Recent activity in the bond market appears to have primed it for longer-term debt instruments; a post COD bond floated by CLP India and backed by the parent company in China, appears to have catalyzed market participation.

PCGs can help bonds achieve the credit ratings required to attract the participation of institutional investors. The PCG for the ReNew Power bond may serve as a template for similar future issuances; ADB served as IIFCL's backstop guarantor and is planning to assume the same role in three more PCGs in cooperation with IIFCL. In addition, IIFCL has circulated a Regular Credit Enhancement Scheme that could similarly boost the ratings of other infrastructure projects (IIFCL, 2015). Such guarantees may be the easiest instruments to pull out of the market as the market becomes deeper and more liquid.

Two twists in the PCG program may allow it to have a wider impact. First, IIFCL or other financial institutions could offer PCGs on a portfolio basis; precedence exists for financiers to offer partial credit guarantees to a portfolio. One example is the World Bank Uganda Series of International Development Association (IDA) Partial Risk Guarantees for Renewable Energy Development Program (World Bank, 2014). In addition, IIFCL could draw upon its cross-sectoral participation to provide PCGs across a number of sectors. While IIFCL is considering building portfolios of PCGs, no such product has yet been issued. One of the barriers to a PCG for a portfolio of bonds is that it is unclear which legal structure would hold the bonds. A combined portfolio structure would not be bankruptcy protected, with the implication that if one project does not service its debt, the entire portfolio could be classified as a non-performing asset. A liquidity vehicle that plugs cash flow shortfalls may permit the required flexibility in the disbursement schedule.

For now, several regulatory guidelines and preferences will shape IIFCL's offerings and participation. IIFCL prefers to take exposures of over INR 200M (USD 3.3M at 1USD = 60INR) and can provide up to a 20% credit enhancement, unless a backstop such as ADB is in place. In the latter case, IIFCL can provide up to a 40% exposure of unamortized project costs. In addition, IIFCL's charter requires IIFCL to prioritize the financing of projects that have secured PPAs.

In the short-term, of course, PCGs may serve only to increase the ROE of the underlying projects. In the ReNew Power case, in addition to delivering a 100 – 150 basis point reduction in the cost of debt, the PCG allowed for the recycling of equity and an increase of the IRR by 200 basis points. In the long-term, PCGs may prompt a deeper, more liquid bond market.

While credit guarantees may be comparatively easy instruments to remove from the financial market, IIFCL is also considering other innovative instruments, such as a project completion risk guarantee. By offering innovations such as the PCG and completion risk guarantee, IIFCL may push other public financial institutions, such as PFC and PTC to offer similar instruments. While public financial institutions may have an adequate supply of bankable infrastructure projects even in the absence of such instruments, their uptake in the market could encourage a greater participation of domestic institutional investors, such as LIC, or private-sector bankR

Recent developments in infrastructure financing may facilitate more liquid loan and deeper bond markets. Both a constant contango yield curve and a limited availability of liquidity contribute to a thin long-term market. New vehicles to list and invest in projects, such as **Infrastructure Investment Trusts** and **Infrastructure Debt Funds**, could increase the liquidity of loans and facilitate a greater exposure among institutional investors to infrastructure. Similarly, while the local debt market is thin, recent issuances suggest a growth trend. Both YES Bank and CLP India recently issued green bonds. Infrastructure bonds, such as that raised by ReNew Power, utilizing an ADB-backed IIFCL partial credit guarantee may help develop the local market as well.

As institutional investment trusts would list only operating projects, they would require an operational manager. The trust would allow projects to avoid double taxation, as interest paid to the trust by the SPVs is allowed as a deduction, without tax withholding. On the other hand, the limited interchangeability of cash with alternatives in these structures (i.e., due to taxation of cash transfers among projects) could limit the use of these structures by developers.

Infrastructure debt funds (IDFs) can be structured as either non-banking financial companies (NBFCs) or mutual funds, with the former restricted to safer brownfield projects (Lambert, 2014). NBFCs are expected to issue debt with domestic ratings of at least AA, meeting the regulatory requirements for investments by insurance companies, pension funds, and provident funds (Lambert, 2014). IDFs also target foreign investment, with lower

withholding taxes on IDFs than general Indian corporate debt. Through greenfield financing or brownfield refinancing, IDFs can grant sponsors long-term fixed-rate financing. However, IDFs have had limited uptake not only because of general challenges in the infrastructure sector but also the nature of incentives to IDF stakeholders. For example, banks are allowed to transfer only guaranteed exposure to NBFC IDFs, such that after a transfer, banks are left with much more unguaranteed exposure (Lambert, 2014). Similarly, foreign exchange risk limits the appetite among foreign institutional investors for investments in mutual fund IDFs (Lambert, 2014).

An IFC-led rupee-linked offshore bond program could increase the access of Indian infrastructure projects to international savings and provide liquidity and depth to an offshore rupee market (IFC, n.d.). IFC will issue bonds in dollars with principal linked to the Indian rupee exchange rate. Under this program, up to \$1B will be converted to rupees and invested in Indian governmental and corporate bonds of tenors of up to ten years.

A shift from a renewable purchase obligation to a renewable generation obligation could address a concern among financiers that wind default rates will increase. If regulators required payment for generated electricity as evidence of compliance with renewable generation obligations, discoms would have an incentive to sign PPAs with wind developers.

Discoms have been hesitant to sign PPAs with wind projects because they can meet renewable portfolio obligations at lower cost by signing PPAs with solar projects, the tariffs for which have decreased considerably. Though lenders have continued to finance wind projects because of a positive history without defaults, the delays in PPA signing raise the specter of future defaults.

5. Comparative benefits and challenges of a bank-led financing model

The Brazilian and Indian examples explore potential advantages and disadvantages of centralized, development bank driven infrastructure finance versus a more decentralized model. After detailed evaluation of specific projects, we find that the benefits and drawbacks are difficult to measure and difficult to attribute specifically to the development banking model versus other features of each infrastructure market and investment. Nevertheless, there are some very clear takeaways from the case studies:

1. The differences between infrastructure finance in the two countries are smaller than a superficial glance at the two models would suggest.

One of the most striking takeaways from a comparison of the case studies is the similar record of the Brazilian and Indian systems along many dimensions. In both Brazil and India, the public sector is leading the financing of renewable energy projects. Projects in both countries display leverage ratios of approximately 70/30, which lag behind the 90/10 levels achieved in more mature markets. The relatively low level of leverage may reflect the lack of true project finance in both countries. In turn, this preference for corporate guarantees (Brazil) or relationship banking (India) may be attributable to the relative absence of risk transfer instruments in the market. Public financial institutions in both Brazil and India are working to rectify this gap and to increase the share of

capital market participation in infrastructure financing.

There were several common challenges facing both India and Brazil, despite the difference in infrastructure financing model. These include:

- **Classic project finance³² is rare**, along with all the innovation and risk mitigation it implies, in both Brazil and India. In Brazil, cross default clauses and required corporate or bank guarantees imply that financing is closer to corporate finance, while in India most finance is relationship driven with recourse to a aren't company's assets.
- **Risk assessment may not be optimized** in either country. Some Indian financial institutions rely on scorecard-based methods of assessing project- and entity-level creditworthiness. BNDES provides a similar share of financing to projects, though it is unclear that all projects require the same level of support.
- **Insurance is generally unavailable to infrastructure bonds**. However, in both Brazil and India, public sector institutions are taking steps to introduce such products.
- **Segmenting of debt into different tranches is limited**, thus limiting the extent to which debt can be tailored to the risk and reward preferences of a wide range of

³² That is, project finance where the debt has access only to the cash flow and assets of the project itself, without recourse to the assets of a parent company (also called "non-recourse" financing).

investors; in almost all cases, debt is not stratified into senior and subordinated debt. However, partial credit guarantees are beginning to emerge in India.

- **Refinancing is generally unavailable** in both countries. However, one of several Indian public financial institutions may soon provide capital for refinancing at concessional rates.
- **The construction finance market is weak or non-existent.** While Brazil has a construction finance market, unlike India, this market depends on BNDES's subsequent provision of long-term debt. Brazilian financiers may be unwilling to accept construction risks if BNDES were to reduce its share of infrastructure financing.
- **Neither model realizes the full potential gains of concessional finance.** In India, concessional financing is the exception rather than the norm and layering of costs due to administrative overhead of running concessional debt through commercial banks reduces the value of the debt concessions. In Brazil, the norm of securing costly bank guarantees raises the effective cost of debt.
- **Neither model fosters much financial innovation.** Middle-income countries may not have the institutions or agents required for the organic development of such innovations. Development banks may be better suited to introduce innovations from high-income countries by, e.g., serving as a market maker. Notably, the decentralized financing model may allow more experimentation,

given the higher number of entry points for innovations (potentially from high-income countries). In a centralized model model, the rate of experimentation may be limited by the capacity of the development bank to experiment.

2. Differences between the two countries have as much to do with differences in policy than with the financing models. In fact, the finance models may be more reflective of the general policy environment rather than a driver of the policy and finance landscape.

In Brazil, BNDES plays a role alongside a well-developed national regulatory, auction and pricing system. BNDES finance enables this mechanism to achieve attractive pricing as bidders can secure attractive financing. In many ways the regulatory and development banking systems have been developed together, each taking advantage of the capabilities and impact on the market.

In contrast, there are wide variations in regulation and policy in India, with risks, financial stability, targets and regulation varying from state to state. National level policy does have an impact, but this impact can often be overwhelmed by state level issues in many states around India.

Although Brazil has variation at the state level and an array of different state institutions, the variation between the states and the relative impact of state level versus national policy and market circumstances is much higher in India than in Brazil. Thus, for example, projects in Gujarat

state in India are relatively easy to finance at attractive prices and can even exhibit more financial innovation than in other parts of the country.

3. Centralized development banking models do, in practice, show clear benefits.

Nonetheless, there are five areas in which the benefits of the development bank-led model are clear. However, associated with each benefit is a caveat; some reflect the benefits of the decentralized financing model we observed in India. National development banks can:

- **Use their scale** to create well-defined niches for different market participants. However, without adequate risk transfer instruments in the marketplace, bank-led models may remain at a sub-optimal level of risk allocation, with simply a separation of construction and operational risks.
- **Facilitate multiple government objectives.** However, without formal cost-benefit analysis, public support may go towards infrastructure projects that do not require it or assist goals that may not benefit society. Banks may be more subject to governmental interference in its lending decisions.
- **Both directly finance projects and guide the evolution of financial markets.** However, the presence of one dominant institution may limit the level of experimentation possible. While we observe a low level of innovation and experimentation in the Indian model, each financing institution has the potential to propose new

innovations. In Brazil, if the innovation of infrastructure debentures does not work, it could take some time for the new innovations to appear, as BNDES is the only institution with adequate scale to introduce them.

- **Enhance liquidity by enhancing exit opportunities for other investors.** However, without varying the terms of debt financing, bank-led systems could provide unnecessarily high returns to some projects, potentially at public expense.
- **Reduce transaction costs of finding low-cost long-term debt.** However, without formal cost-benefit analysis the selection of projects to finance, national development banks can remove opportunities for commercial and international financiers. Similarly, without a clear and transparent complementary regulatory and policy regime, the level of infrastructure development and financing may be low, even when low-cost financing is available from a national development bank.

4. Development bank models could do more than was observed in Brazil

While we did not observe some of the potential benefits of a bank-led model in Brazil, bank-led models could deliver those benefits, if the appropriate institutional design and decision-making procedures are in place. Drawing upon the potential benefits listed in our comparison matrix, we suggest that banks can:

- Consider their investments as part of a diversified portfolio

across the economy, with their involvement in different sectors potentially allowing them to absorb more risks in any given sector

- Facilitate the transfer of risk across agents of the economy by serving as a market maker in a construction financing facility; indeed, a national development bank could also serve as a market maker in a pre-construction financing facility or transition financing facility
- Enhance the liquidity of investments made by international, institutional, and commercial investors by serving as a market maker in a debt exchange facility or by aggregating and listing infrastructure investment funds.

Most of these functions can be performed even in the absence of a national development bank. Within infrastructure financing models such as that in India, public financial institutions can guide the evolution of financial markets by introducing innovative risk-sharing instruments or serving as the market maker for construction financing or debt exchange facilities.

5. But centralized models can also learn from the checks, practices and safeguards inherent in the decentralized model.

We also find that the NDB-led model could be improved by adapting several practices and safeguards, some of which exist in the decentralized model. Moreover, both

centralized and decentralized models entail several challenges that may be common to middle-income countries, in which financial institutions and players are not as developed as those in high-income countries. Cognizant of this, we suggest that national development banks assume different roles in economies at different levels of development. In particular, national development banks in low-, middle-, and high-income countries could focus on directing and coordinating flows of development finance, providing concessional loans while building thick and liquid long-term debt markets, and supporting financial innovations, especially in new technological areas, so as to later introduce those innovations in middle-income countries, respectively.

Appendix A. Background on potential participants in infrastructure finance

Our discussion has focused on the roles of public financial institutions, whether in the form of a NDB (BNDES) or a decentralized set of institutions (e.g., IIFCL, IREDA, SBI). We do not intend to imply that publicly funded infrastructure financing models are inevitable or ideal. Indeed, financing models should be appraised on their ability to direct the lowest cost capital towards infrastructure projects. With the right institutional, policy, and regulatory structures, private investors can provide considerable low-cost capital.

Private-sector investors can be broadly segmented into corporate participants, who generally directly invest in infrastructure projects as part of their regular operations, and institutional investors (McKinsey, 2015). Institutional investors may indirectly invest in infrastructure by holding corporate debt and equity, directly in infrastructure projects, or indirectly through investment managers, private equity funds, infrastructure funds, and other pooled investment vehicles (Nelson and Pierpont, 2013).

The institutional investor class includes a wide variety of investors, including pension funds, other pension assets (e.g., pension reserve funds), IRA and insurance contracts, insurance companies, sovereign wealth funds, foundations and endowments, and investment managers (Nelson and Pierpont, 2013). While estimates of the assets under management (AUM) by institutional investors range from \$71T (Nelson and Pierpont, 2013) to \$120T (McKinsey, 2015),

such investors hold a sizable pool of funds that could finance infrastructure projects.

Among institutional investors, McKinsey (2015) estimates that banks, investment companies, insurance, and pension funds account for 88% of AUM. These large players generally hold savings or principal from the general population with the promise of providing reliable cash disbursements in the future. Given this liability structure, such investors look for low-risk, long-term investments (Nelson and Pierpont, 2013). Some infrastructure projects have this structure; they entail large initial capital outlays, a low price elasticity of demand and correlation with business cycle, the potential to incorporate inflation hedges in contracts, a predictable free cash flow, and an attractive risk-adjusted cash yield (Blanc-Brude, 2014). Theoretically, returns on infrastructure investments could allow institutional investors to meet long-term obligations to depositors and fund members.

In practice, however, the volume of investment by institutional investors remains relatively low. Several factors explain this apparent mismatch.

Two of these factors are the heterogeneity in investors' objectives and the cash flows entailed in infrastructure projects. The variation in investors' return targets implies that investors differ in their willingness to purchase exposure to risk. Further, the correlation of infrastructure project returns with other asset classes varies widely. Weber and Alfen (2010) demonstrate that while infrastructure has a 0.21 – 0.62 correlation with real estate projects, the analogous figure for private equity investments is -0.3 to 0.12. A third factor is the variation in risks inherent to

similar projects. Naturally, an investor's willingness to invest in infrastructure projects will depend not only on the correlation between projects and the rest of her investment portfolio but also on her risk tolerance. A substantial share of infrastructure projects entail significantly more risk than the idealized infrastructure project with stable cash flows and a near zero correlation with business cycles. Weber and Alfen (2010) illustrate that the return and risk characteristics of similar projects can vary considerably. While an operational asset developed in a public-private partnership, with availability-based revenues, and minimal demand risk is a very safe asset, a pre-construction asset that is exposed to large demand risk is not. Many infrastructure projects in middle-income countries present additional risks, including macro country risk, exchange rate risk, and policy risk.

Given the heterogeneous risk and return characteristics of infrastructure projects, the participation of institutional investors is likely to depend on the availability, in a given country's capital market, of instruments designed to optimize the allocation of risks among different investors. Accordingly, middle-income countries in which the public sector forms the basis of the infrastructure financing model may want to prioritize the development of risk allocation instruments, such as partial credit guarantees and completion insurance, and practices such as debt tranching. Such instruments could allow institutional investors to customize their participation in infrastructure financing so as to achieve their ideal risk-return characteristic.

This perspective suggests that the innovative capacity of infrastructure

financing models is particularly critical. A limitation of the NDB-led model is that the rate of innovation may be reduced by the dominant position of the NDB in the financing landscape. NDBs in middle-income countries, where financial institutions and agents may not have the sophistication to develop or demand such instruments, may provide greater social benefits by serving as conduits for such innovations from high-income countries. NDBs can serve as market makers for such instruments or guide financial markets to accept these products. The same guidance holds for middle-income countries with a decentralized financing model. The greater number of institutions may be able to more introduce a larger number of instruments to the local market but additional coordination may be required to ensure acceptable risk taking and prevent the emergence of unintended interactions between non-complementary instruments.

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