

Public Investment for Sustainable Development

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Ehtisham Ahmad¹

Abstract:

The SDGs have reignited interest in investment, particularly in public infrastructure. International financial institutions (IFIs), such as the IMF and World Bank, have issued sensible new “good practice” guidelines. While most are non-controversial, we argue that they are not sufficient to ensure sustainable development. In this paper, the first of two papers that focus on the investment cycle, we address questions on “what” to invest in and “where”. We focus on Chile, which meets most of the recommended criteria and is appropriately held up as an example of efficient and transparent management of investment. But, over two decades the economy has become less “complex” and reliant on primary exports with limited utilization of its enormous potential. It suffers also from spatial disparities, inequality, and congestion and pollution in the metropolitan areas. We show how a system of economy-wide shadow prices linked to a sustainable growth strategy, and the creation of new “clean” hubs can help. Although national connectivity is critical, local investments in infrastructure and public services are also critical in making the “hubs” attractive for private investors and sustained employment generation.

¹Ahmad is affiliated with LSE, University of Bonn and Zhejiang University. Helpful comments from Marilou Uy, Aldo Caliri, and participants at a G-24 seminar in Addis Ababa in February 2017 are acknowledged.

I. Executive Summary and Introduction

Emerging markets and developing countries are placing renewed emphasis on public investment for inclusive and sustainable growth to attain the new SDGs. Given the need for productive public investments and given limited financing possibilities, badly designed and poorly implemented projects may not result in sustainable generation of employment opportunities. Indeed, they may lead to increasing inequality, congestion, and pollution in major metropolitan areas, as well as a buildup of liabilities that cannot be financed. The political economy tensions between levels of government may also be exacerbated, with both national and supranational investments. While there are considerable hopes that increased cross-border and internal connectivity will generate a better integration of value-chains and generate gains from trade, including within the EU, some of the problems in relation to effectiveness and sustainability, as well as employment opportunities in lagging regions have been highlighted following the 2008 crisis in Europe (Ahmad, Bordignon, and Brosio, 2016).

In recent years, international financial institutions (IFIs) (especially the World Bank and IMF, but also the OECD) have issued guidelines or codes to help emerging market and developing economies better manage their public investment programs. Many of the elements are largely sensible and could be considered as *necessary* conditions. However, as argued below, these are far from *sufficient to ensure sustainable development*. This is seen in the case of one of the “star performers” for the IFIs — Chile. While Chile’s investment process is indeed well managed, the outcomes in terms of sustainable and inclusive growth are far from satisfactory. The IFI prescriptions on public investment and the Chilean experience, with a focus on outcomes rather than process, are examined in Section II.

Chile illustrates that investments in highways to improve connectivity, well managed though they are, and a system of capital transfers linked to indicators of need, have not generated development evenly. Private investment and employment opportunities remain concentrated in the metropolitan area, together with high levels of interpersonal and spatial inequality. Some

convergence is apparent in recent years, but this is due to a slowing of growth overall and in the metropolitan areas, leading to perceptions of a middle-income trap. We examine in Section III some options to create “clean cities” as hubs for balanced, inclusive, and sustainable growth.

Additional units of public supplies or investments are like taxes in that they affect not just private producers, but also households under different circumstances, as well as the distribution of income. In determining investment priorities, allowances must be made for possible distortions in the economy, congestion, and pollution, to get to underlying “social” costs and benefits. Using insights from the theory of reform and examples from South Asia (Ahmad and Stern, 1987 and 1991) and Mexico (Coady, Musgrave, Seade, et al., 1986)² in Section IV we illustrate how an economy-wide system of shadow prices would improve the portfolio of investments in Chile. However, deriving consistent shadow prices would require assumptions about capital and labor, incorporation of the social costs of carbon use and congestion, and assumptions concerning the extent of inequality aversion on the part of policy makers. Choosing the most appropriate shadow prices for the economy, among the myriad of possible options, should be driven by the medium-term growth strategy and reflect the skills and endowments in the economy.

Section V concludes by stressing the importance of a set of overlapping models and policy actions, and suggests an agenda for further work. Investment decisions should be consistent with the government’s macro-fiscal stance, particularly the growth and income distribution objectives. This reinforces the coordination function that the IMF and OECD guidelines correctly emphasize, but in a more specific manner than either institution has envisaged. Making investments consistent with public policies also involves multilevel tax measures, to ensure proper incentives for firms, as well as access to credit, especially at lower levels of government. The latter is a critical, albeit often overlooked, aspect of the public investment agenda. Complementary subnational investments and local public services are needed to

² See also Drèze and Stern, 1987.

supplement national/cross-border connectivity investments for clean cities and sustainable “hubs”, so that overall the effects reduce inequalities and generate growth.

Public investments in, for example, national or cross-border connectivity, need to be accompanied by supporting taxes and social spending at different levels of government. This would ensure that medium-term growth paths are realized. A combination of policies will also determine the incentives facing producers and workers, and help address the political economy aspects of public policy at various levels of administration.

Given revenue constraints, it is important to involve the private sector in public investments in financing, but also management. In an earlier G-24 paper (Ahmad et al., 2015) we focused on the potential and risks associated with PPPs in various sectors, and the growing appreciation of the preconditions to make PPPs work efficiently, pointing out difficulties with asymmetric information as well as game-play concerning liabilities at different levels of government. With the very significant financing requirements for the new SDGs, there is renewed interest in making PPPs work, including in China. At the same time, there is recognition that the private sector is reluctant to invest in the construction phase with its frequent delays and cost-overruns, preferring to be involved in later stages when revenue and income streams are more predictable (see Bhattacharya et al., 2016 and the companion G-24 paper, Ahmad, Vinella and Xiao, G-24 2017). In the UK, for instance, the Treasury established the Pensions Infrastructure Platform (PIP) in 2011, expecting to raise £20 billion for financing public transport and energy projects. To date the PIP has raised only £1 billion, as sovereign wealth funds, and institutional investors, pension funds, and insurance companies prefer assets with steady income streams. The companion G-24 paper (Ahmad, Vinella, and Xiao, 2017) summarizes some of the recent literature on the appropriate bundling of contracts with different profiles of risk and uncertainty — an issue critical to the climate change and sustainable growth agenda.

II. Applying International Agency Investment Guidelines — the case of Chile

The Bretton Woods institutions (World Bank and IMF) and the OECD have developed useful guidelines for investment management that address many important operational aspects of public investment. Chile is praised as an example for other countries for achieving growth and poverty reduction along with prudent macroeconomic management. However, despite the well-deserved praise, growth has slowed and is highly dependent on volatile demand for exports, and inequality has increased. There is scope to improve the investment process in Chile to better address long-term sustainability, avoid the middle-income trap, and achieve more inclusive growth.

1. The IFI Investment Guidelines

The international agencies have been strengthening their own perspectives on public investment, and these largely reflect their specific priorities and mandates. The World Bank Public Investment Management Assessment (PIMA) guidelines tend to focus on the project life cycle. While the Bank provides a repository of information on PPP projects, enabling some assessment of what can go wrong; the information is fragmented and does not include the intertemporal liabilities likely to be generated. Consequently it is difficult to formulate public policies needed to cope with sustainability issues (see Ahmad, Vinella, and Xiao, 2017). Nevertheless, the PIMA guidelines provide useful insights into the institutional, regulatory, and legal frameworks to improve the probability of success. Chile was highlighted as an example of effective public investment management (World Bank 2006).³ The Bank advises on transformational sectoral investments in keeping with its areas of expertise (Monari, G-24, 2017).⁴

The OECD, too, has developed a flexible investment governance toolkit that focuses on aspects of effective public investment management across levels of government. It also provides

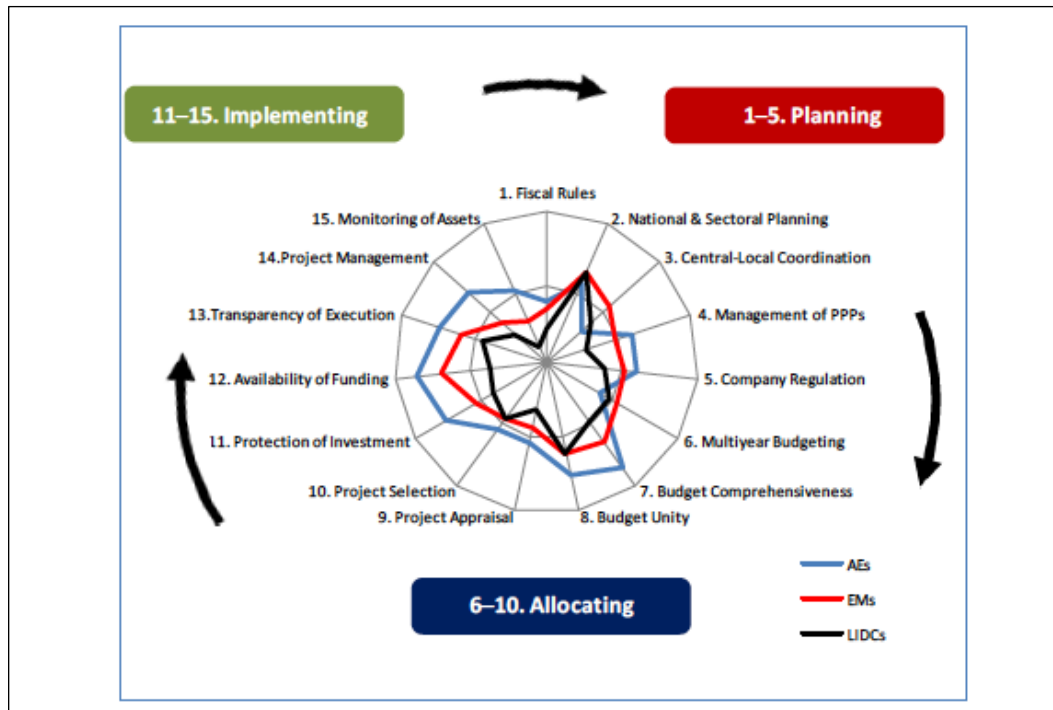
³ World Bank, 2006, Chile Public Investment Management Review.

⁴ Monari, G-24 Workshop, 2017.

examples of “best case” examples for the various components. For instance, *Chile Compra*, is reported as a model for public procurement for OECD countries.

The IMF has developed a complementary PIMA⁵ of its own, providing a ratings-like assessment of investment that covers central-local coordination, national and sectoral planning, transparent project selection processes, improved management of infrastructure assets, and enhanced oversight and control over PPPs. Chart 1 shows the overall assessments for regional groupings of countries, and individual country assessments that are underway. Chile performs well in relation to most of the listed criteria.

Chart 1: IMF PIMA Criteria and Aggregates Scored by Groups of Countries



Source: IMF, 2015.

⁵ IMF 2015, *Making Public Investment More Efficient*, June, Washington, DC.

Would meeting the IMF/OECD/World Bank criteria be sufficient to generate sustainable growth? While the stipulated items provide largely sensible checklists, and may be *necessary* to ensure that investment is well managed, they are unlikely to be *sufficient*.⁶

The IMF's emphasis on managing risks from the investment agenda, including from the PPP process, is entirely appropriate. In this context, the IMF's GFSM 2001/2014 framework is relevant not only as a fiscal reporting tool, but also to generate full information on a consistent basis across levels of government — constituting general government operations and balance sheets in the medium term. This is important to prevent game-play between and across levels of government (Ahmad, 2015). Ahmad, Bordignon, and Brosio (2016) have shown that the absence of clarity and uniformity in liabilities, including those of PPPs at subnational levels in the EU, has contributed to the depth and extent of the crisis in many countries.

2. Lessons from the Public Investment Experience of Chile

Chile performs well relative to the IFI criteria, especially the much-praised national investment system, the SNI. In this paper we examine Chile's connectivity infrastructure, often but not exclusively at the cross-border level. Examples from the North-South Highway in Chile, adds to the experience of structural funds in the EU, and to rebalancing in China, designed to shift production and consumption from the congested Eastern "hubs" into the interior. These illustrate that investment in road and rail links might be necessary to expand the production-possibility frontiers, but are not sufficient to ensure that the rebalancing takes place. We highlight both national and local tax policies beyond the obvious revenue potential as these affect incentives facing firms and governments at different levels, and directly and indirectly influence the creation and success of potential new growth "hubs".

Over the past two decades, Chile has been among the top Latin American performers in terms of macroeconomic management — with a low stock of debt (21 percent of GDP, a doubling since 2010), low deficits, a sovereign wealth fund, tax/GDP ratio of around 18 percent (within

⁶ We draw from the criticism of mechanical applications of the IMF-World Bank Debt-Sustainability Framework by authors such as the former Chief Economist of the World Bank, Justin Lin (Lin and Wang, 2016).

the range suggested for the Millennium Development Goals), and a private sector-oriented policy stance. Growth has exceeded that of neighboring countries, including the crisis period since 2010 (IMF 2016).⁷ This has significantly reduced overall poverty over the past 20 years. Macroeconomic policies are bolstered by an arms-length and uniform approach to public investment through the SNI, and a transparent procurement process, *Chile Compras*. Both have been praised by the IFIs as examples of how to manage the public investment process. The North-South Highway is designed to provide connectivity, despite a very long and difficult mountainous terrain. It is reportedly well constructed and maintained. However, spatial inequalities have not been effectively addressed.

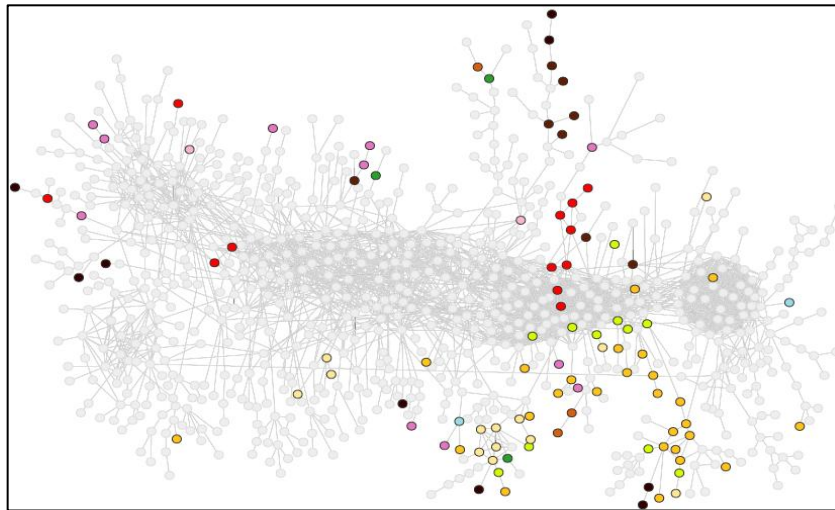
Chilean growth has been largely sustained by commodity exports, especially copper and agricultural raw materials, especially to China in the recent decade, offsetting declining productivity growth. The result has been what President Ricardo Lago (2013) called the “middle income trap.” As is common in primary commodity exporting countries, there has been limited development of domestic linkages. This is reflected in the very limited economic complexity (Chart 2) — showing 2014 to be lower than in 1995. This is a consequence of the greater reliance on primary commodity exports, and symptomatic of Dutch Disease. In relative terms, the negative value of the economic complexity index shows that the full economic potential of potential domestic linkages and employment generation has not been realized (Hausman et al, 2016, see also Chart 3). This has left the country exposed to external shocks. Chile is particularly vulnerable to shifts in demand for its copper exports, especially to China (IMF, 2016).

A further consequence of the growth and investment strategy is the concentration of activities in the ports and metropolitan zone, including Santiago, despite the investment of the North-South Highway. Regional disparities are high, and there is increasing congestion and pollution in the Metropolitan Zone.

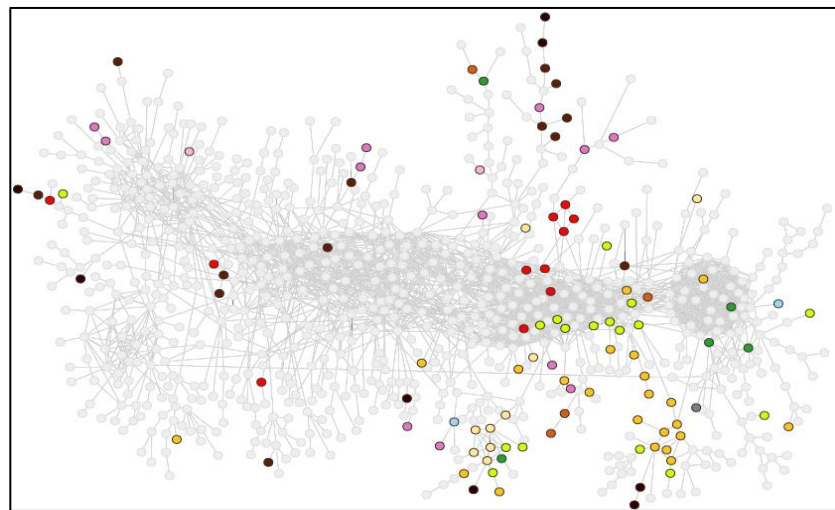
⁷ IMF, 2016, Chile — Article IV Consultation Report, December, CR 1637.

Chart 2: Structure of Complexity in Chile, 2014 & 1995 Compared

2014 (US\$73.2B)



1995 (US\$15.6B)



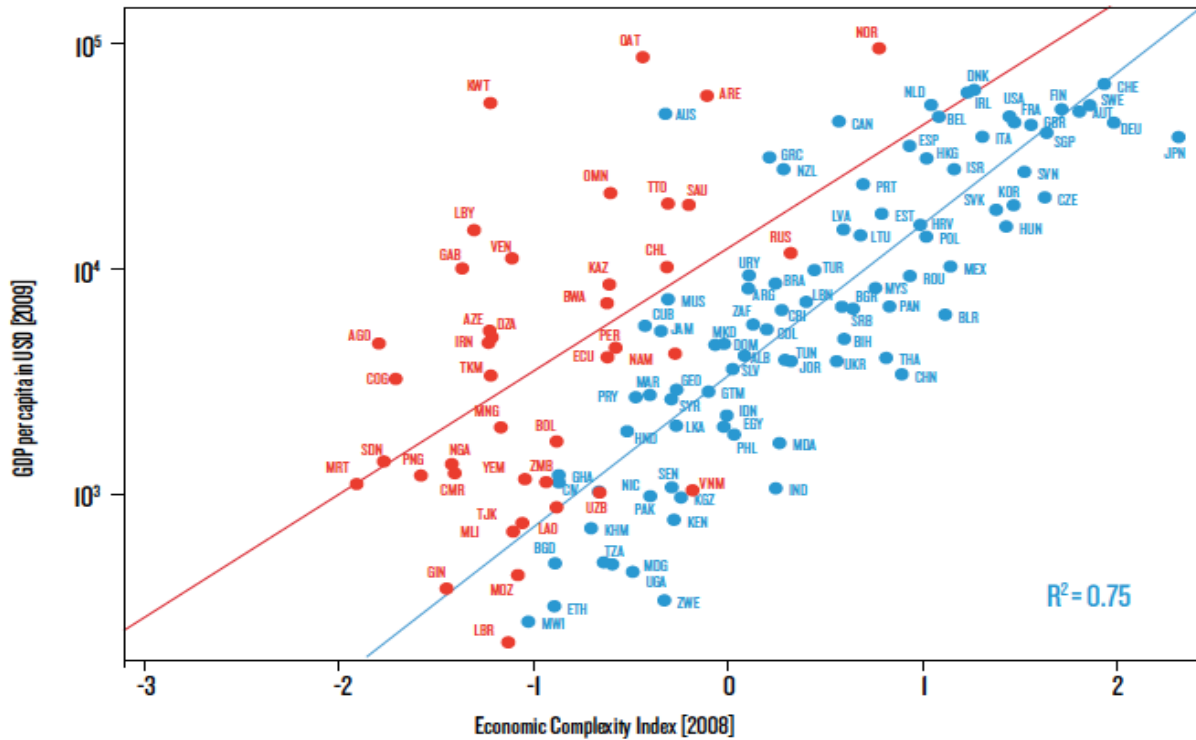
Legend of sectors by color/tone:



Note: These charts show linkages for various sectors, from primary production in the outer ranges to more complex processing in the interior (each color and/or tone represents a sector). The paucity of connections signifies a primary exporting economy. The denser the interconnections the greater the domestic utilization of value chains.

Source: Hausman et al. *Atlas of Economic Complexity*, Harvard-MIT Complexity Project.

Chart 3: Economic Complexity Index for Natural Resource-rich Countries (in red) and Others



Source: Hausman et al., *op cit*.

In Chile, migrants from the less well-off regions head to the “Metropolitan Zone”, because that’s where the jobs are, given the limited diversification of the economy. This causes crowding in peripheral shanty-towns with poor facilities, including for education and other public services.

The regional imbalances also have led to persistent pockets of poverty in the lagging regions. There was an increasing incidence of poverty in 20 of 26 functional urban areas, 8 of them with a clear regional pattern. More worryingly, the largest concentrations of the poor (40 percent of the total) are in the metropolitan area, although it has the highest per-capita incomes and employment opportunities. The income inequalities are magnified by the inequalities in access to public services (Chilean Household Survey--CASEN, 2015). This also is reflected in the provision of tertiary education, for which there is limited public funding. Consequently,

⁸ See OECD, 2013.

interpersonal inequalities are also increasing, with the Gini coefficient in Chile well above those of the OECD.⁹

Addressing interpersonal inequalities depends on a more effective operation of the personal income tax (PIT) system, and the development of an efficient property tax system linked to the delivery of public services (Ahmad, Brosio, and Pöschl, 2015). Given the poor performance of the PIT in Chile, and in developing countries more generally, generating additional third-party information from asset holdings, particularly property, suggests the importance of both a regional/local surcharge, or “piggy-back”, and a more efficient system of property taxation. However, for such a tax system not to widen inter-regional inequalities, an equalization framework is needed, but does not yet exist in Chile (Ahmad, Letelier, and Ormeño, 2016).

In Chile, regional connectivity, in the form of the North-South Highway, is important, and will certainly play a major role in the future. However, it has not reduced regional inequalities, as the preconditions for local “hubs” outside the Metropolitan Zone are not met. These include the provision of basic services and complementary local investment to make better use of the national infrastructure for greater connectivity. This is partly due to the absence of effective tax handles at the local level. In particular, a Robin-Hood system of local transfers through the *Fondo Común Municipal* (FCM, or Common Municipal Fund) destroys incentives for richer municipalities to raise property tax revenues, as these are shared with the poorer municipalities. The latter also have no incentive to raise revenues as doing so reduces transfers from the FCM (see Ahmad, Letelier, and Ormeño, 2016). The feeble overall local tax effort limits the ability of local governments to access credit markets for the needed local infrastructure financing requirements. Similar problems have been observed with the connectivity infrastructure in the EU — e.g., in Spain and Italy, where there is a more severe political economy game-play between levels of government and the management of liabilities.

Without the creation of the new “hubs”, or clean new cities, including in the less well-developed areas, regional inequalities might increase. The recent development of solar energy

⁹ IMF Staff Report, 2013.

in Chile, providing some of the cheapest forms of clean power, also opens-up the potential for generating new hubs, if the local preconditions for complementary infrastructure are created. The Chilean examples are relevant to the rebalancing of activities and investment in China, and the Belt and Road Initiative focusing on cross-border connectivity in Europe, Asia, and Africa.

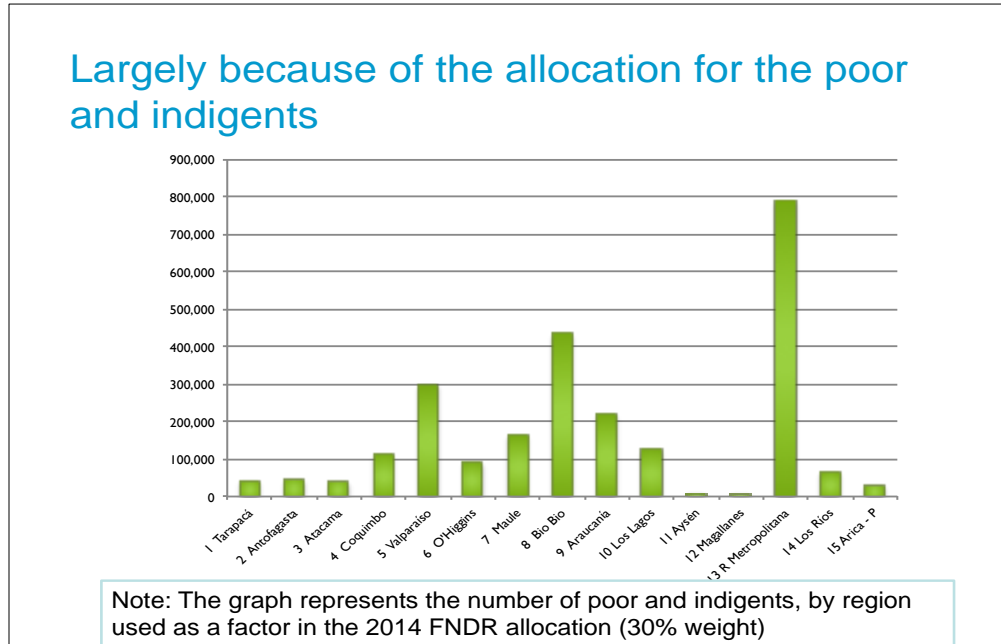
There has been an explicit attempt to address distributional concerns in Chile by allocating capital transfers to subnational governments through the *Fondo Nacional de Desarrollo Regional* (FNDR) based on various needs indicators, such as:

- Poverty indicators (e.g., numbers of poor, proportion of population; female-headed households); and
- Cost differentials for housing and infrastructure.

While these are sensible criteria, they end up providing most of the investment resources to the richest metropolitan regions. The spatial inequality is due largely to population migration and dynamics, as the poor migrate to look for employment in metropolitan zones. This results in the highest concentration of poor and female-headed households in the metropolitan areas (see Charts 4-8). The tendency is not offset by the differential cost factors. Consequently, the highest FNDR transfers are to the metropolitan areas, given that the dynamics of population and investments combine to increase spatial inequality (within regions and nationally). While it could be argued that the FNDR amounts are relatively limited, these do not begin to address the spatial inequality or sustainable development questions.

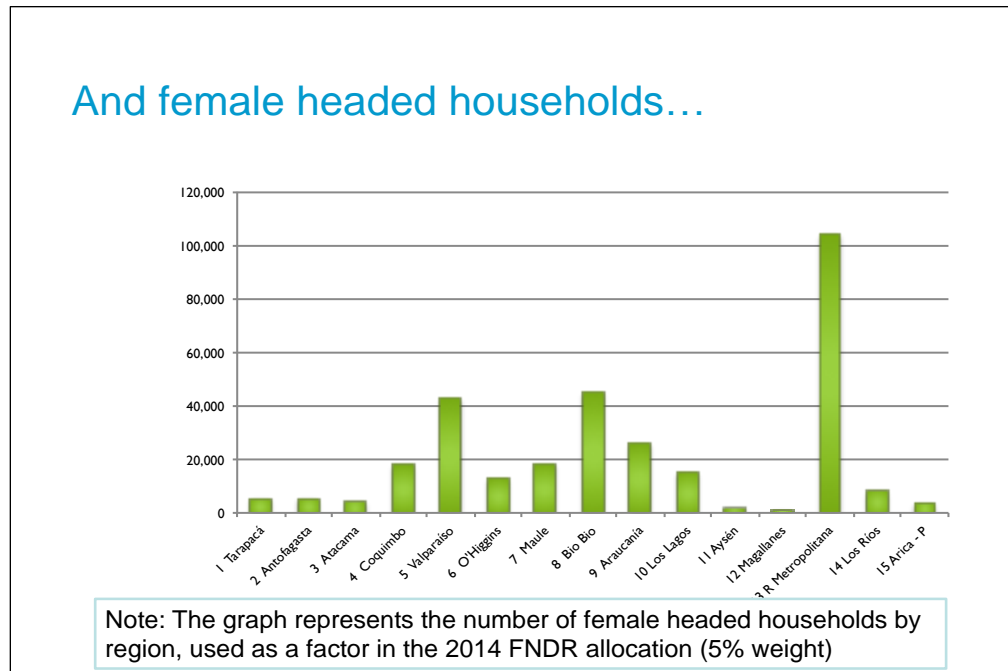
For public investment to address the SDGs, it must address the issue of the creation of clean cities, with skills and innovation in new hubs, together with a more consistent use of shadow prices to govern the choice of national and regional projects.

Chart 4: Allocations for the Poor and Indigent in Chile



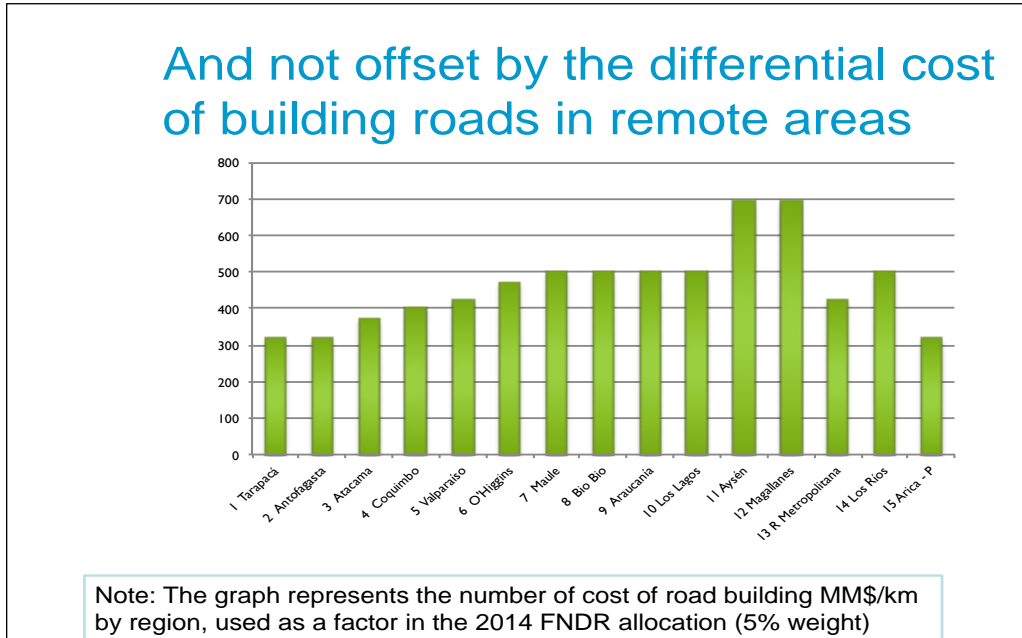
Source: SUBDERE, Chile.

Chart 5: Importance of Female-headed Households as Criterion for the FNDR



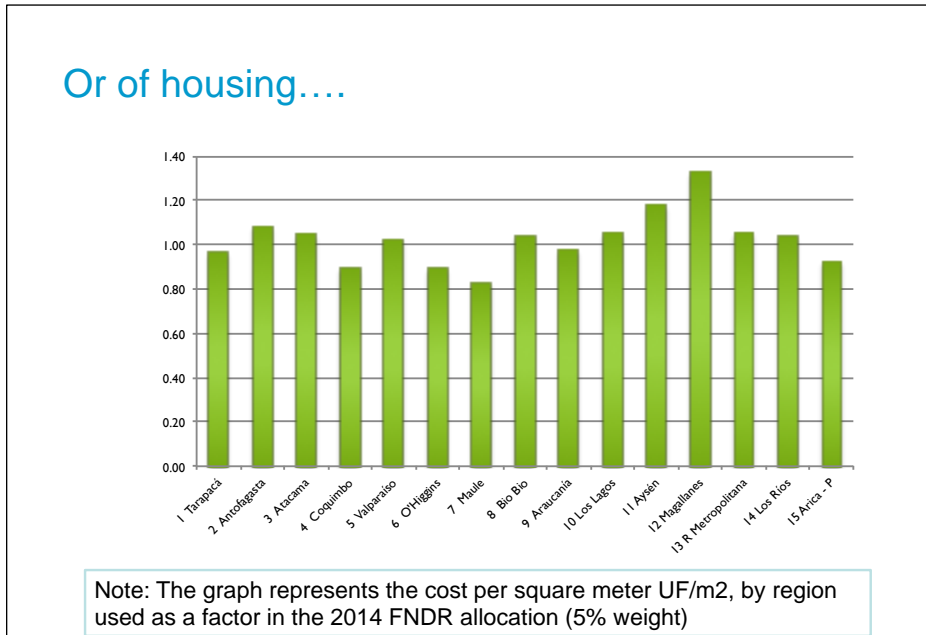
Source: SUBDERE, Chile.

Chart 6: Role of Cost-Differentials — Roads



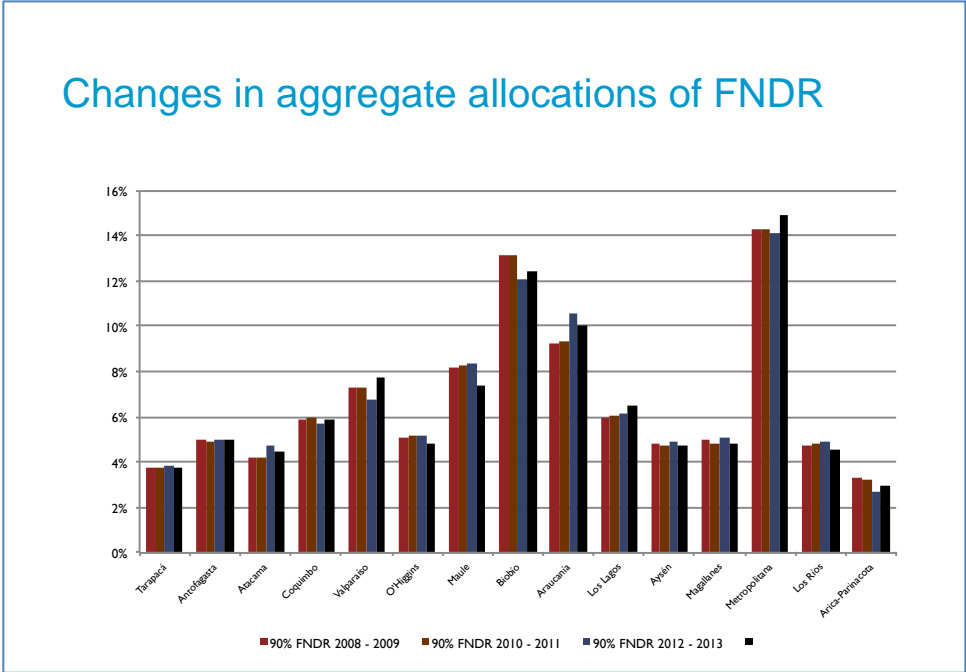
Source: SUBDERE, Chile.

Chart 7: Role of Cost-Differentials — Housing



Source: SUBDERE, Chile.

Chart 8: Changes in Aggregate Allocations of Chile’s FNDR by Region



Source: SUBDERE, Chile.

III. Urban Hubs —“New Clean Cities?”

One of the main components of a sustainable development strategy is based on new clean cities, or revamped older cities, at some distance from the existing metropolitan hubs. As the Chilean, Chinese, and EC experiences show, connectivity is necessary to, but not sufficient in creating hubs. In Italy, for example, the North-South High Speed Train and Motorway links have not succeeded in reducing the gaps between regions; and in Spain and Portugal, speculation by local or regional governments with poor monitoring of liabilities, including those of PPP contracts, has contributed to the economic crisis since 2008 (see Ahmad, Bordignon and Brosio 2016).

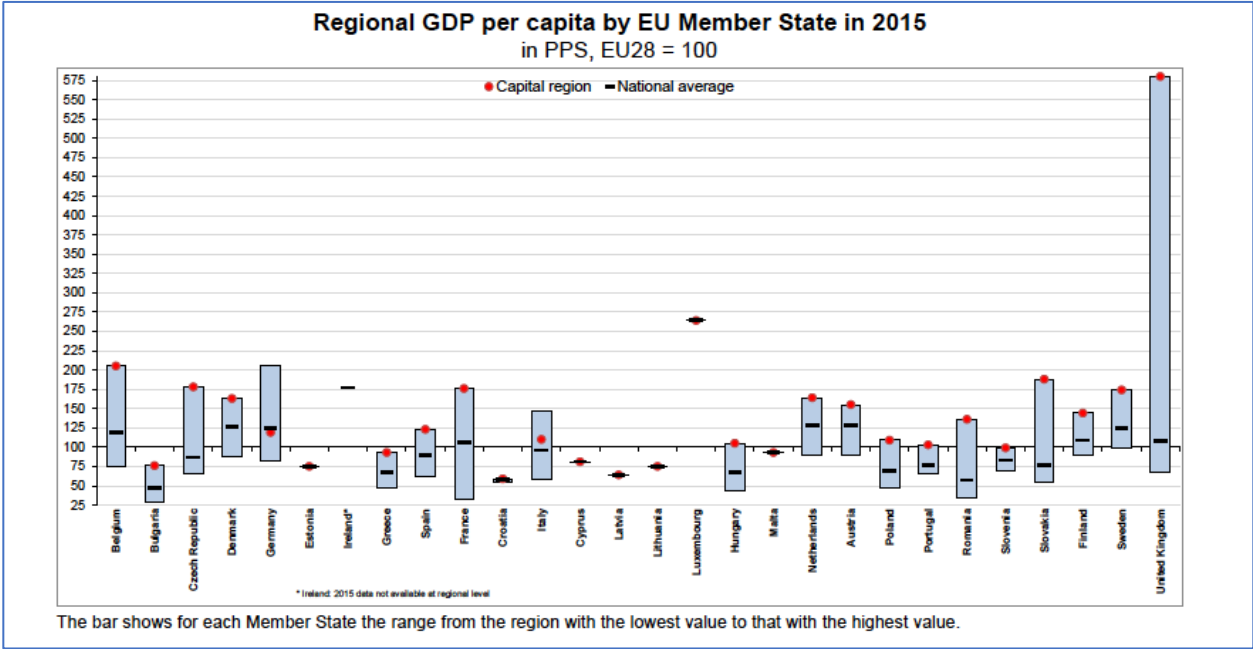
The UK has some of the best connectivity in Europe, with North-South train and motorway links, as well as international airports. However, as the recent Eurostat report shows, this was not sufficient in preventing the highest inequality of European cities — far exceeding those in any country on the Continent (see Chart 9). The connectivity only increased the migratory pressures on the capital, London. Meanwhile, London’s high property prices relative to the rest

of the UK, and the absence of requisite skills for the high-tech and financial sectors generating the high incomes in the capital, made it impossible for significant equalizing domestic migration to take place. This pattern is similar to that of Chile and other emerging-market and developing countries — the difference being that shanty towns are unlikely to emerge in London’s Green Belt for the less-skilled workers. This highlights the point that connectivity, while a necessary condition for growth, is not sufficient in ensuring economic or political sustainability.

Chile has huge potential for development of new clean cities and activity hubs, given the success it has had with renewable energy. Costs of solar energy have dropped precipitously — in 37 winning auctions globally from 2013-16, Chile was consistently among the lowest bids, at US 2.9cents/kWh, easily beating the 18.4cents/kWh of Indonesia, and 6.5 cents/kWh of Brazil and South Africa (Monari, G-24 presentation, 2017). This is a huge technological advantage and could be a true “game changer.” However, as with the issue of road and rail connectivity, much depends on the tax agenda and local service delivery needed to make new “hubs”, or clean cities, feasible and enable rebalancing or convergence to take place.

The essence of “convergence” is when faster growth enables lagging regions to begin catching up with the advanced regions in per-capita incomes and employment-generation capabilities. This is driven largely by the private sector, although the public sector has an important role to play, too, through investments in human and physical capital.

Chart 9: Regional GDP per capita, EU Member States, 2015

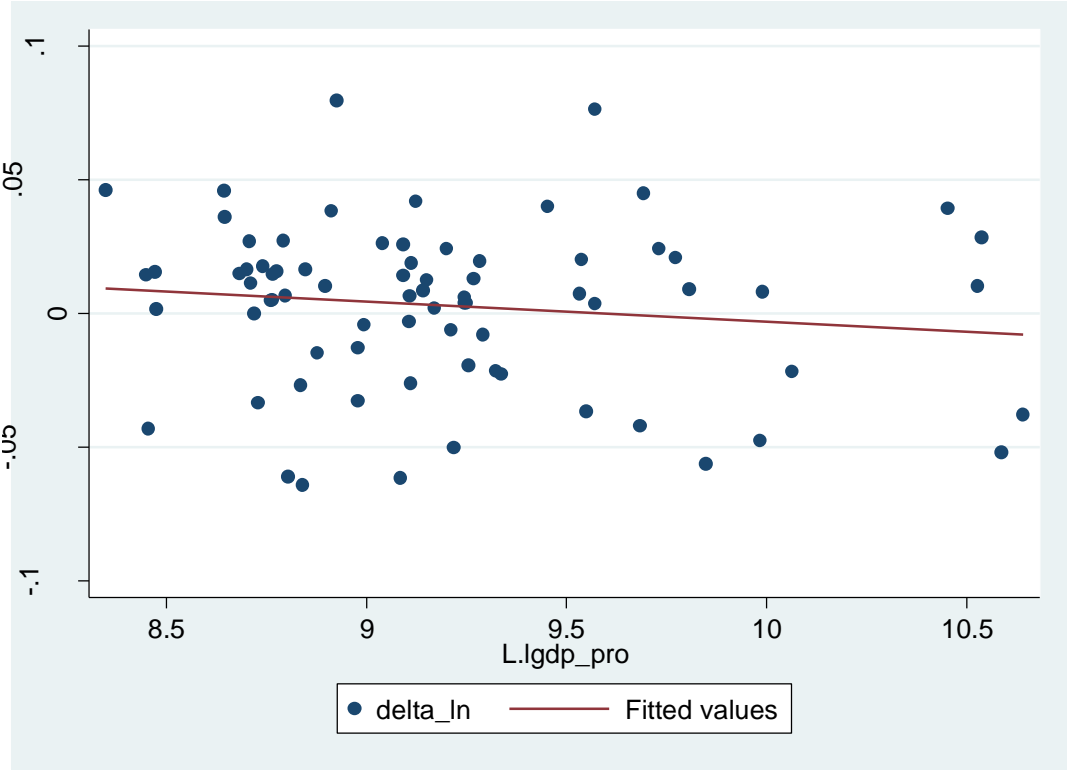


Source: Eurostat, 2017.

To some extent, convergence is already taking place in Chile, as we shall see below, but due largely to slowing growth rates in the metropolitan areas, because of capacity constraints and congestion, as well as the economic slowdown since 2008 with the international economic crisis (see Chart 10). This is also a manifestation of the “middle income trap” facing Chile and other emerging market economies, and the challenge of maintaining sustainable growth and employment generation.

The role of public investments would be largely to facilitate private investment in sustainable “hubs” that reflects the comparative advantages of the country and provides sustainable employment generation. A convergence of growth rates with sustainable development throughout the country clearly requires a better distribution and utilization of “enabling” public investments in physical and human capital.

Chart 10: Chile — Convergence Links with Human Capital Potential



Note: The scatterplot shows growth in per capita GDP (vertical axis) and $\ln(y_{t-1})$ (horizontal axis) for regional income levels in 2016. The straight line represents the fitted line of the linear regression in each scatterplot. Convergence intensity is determined by the slope of the size: the greater the slope the greater the convergence rate.

Source: Ahmad and Zanola (IADB, 2016).

The role of the local or regional tier is important for the effective provision of public services as well as supplementary investment needed to fully utilize the potential of improved connectivity.¹⁰ Interior “sustainable” hubs are possible, provided they optimize sources of supply (including a skilled labor force), as well as potential demand (domestic consumers as well as exports). Measures such as cash transfers to the poor may not close regional “gaps” or even reduce poverty (as in Chiapas, Mexico — see Ahmad, 2015).

Tax breaks, such as through Special Economic Zones (especially for VAT), may do little more than create holes in the tax system for abuse without generating sustainable private investment. Consequently, it is important to align incentives for the private sector, as well as

¹⁰ Granados, Sergio and Jorge Rodríguez, 2013. *Nueva Agenda Regional: Propuestas para avanzar en descentralización fiscal en Chile*. Mimeo.

workers, to ensure that investments lead to sustained growth of employment opportunities without the need for continued preferences or “holes in the tax system” that enable cheating.

Chile’s current growth strategy is depicted graphically in Chart 11. It shows most growth concentrated in the metropolitan areas and the ports, represented as “A”. With existing transport links (f), the furthest peripheral areas P are able to utilize the export and demand patterns generated by A. But the extreme peripheral areas, or the *zonas rezagadas* (P_N), are unable to connect either to the markets or domestic or external supply chains of A or P.

A characteristic of P_N is that the infrastructure gaps are binding. Consequently, giving a tax holiday will lead to a perpetual subsidy, but may not be enough to ensure that the private sector will have an incentive to invest there. Similarly, a cash transfer to the poor in P_N likely means that they will have a reduced incentive to migrate to the metropolitan areas of A, in search of work or to obtain improved skills. Therefore, it does not ensure that private investment will be forthcoming.

New “sustainable growth hubs” (N) would typically focus on regional comparative advantage. As mentioned above, this has changed significantly in Chile with the breakthrough in cheap and clean solar energy. This is also a function of availability of requisite skills, wider connectivity to domestic and external markets or suppliers, and local connectivity to the hinterland — i.e., in diversified industries benefitting from cheap energy, agriculture or, as in Chile’s case, tourism. Consequently, the nature of the hubs will vary according to the relevant endowments.

The placement of investments is in turn a function of project selection methods. There is the case of the famous Chacao Channel Bridge that was initiated under the Ricardo Lagos regime to open Chiloé Island, but was cancelled after a largely commercial cost-benefit analysis indicated insufficient demand and traffic on the island. However, the demand and activity levels on the island are dependent on the bridge, so past trends would not be appropriate as an indicator of future demands. Indeed, investments in the potential port(s) on Chiloé Island are a function of supplies and linkages with the mainland. In a similar context in Malaysia, the generation of a clean “hub” on Penang Island was dependent on not just one but two bridges to the mainland. And in Pakistan, the investment in the port facilities in Gwadar makes little sense without the connectivity to the rest of the country, as well as to China and elsewhere in Central Asia. Furthermore, the road and rail links from the Chinese border must be seen in the context of the rebalancing strategy in China itself that seeks to move production and exports to the West and interior from the congested and polluted mega-cities of the Eastern Coast (see Ahmad, Niu, and Xiao, 2017).

Better integration with international value chains, such as those through new cross-border investments and development of deep-sea port facilities, depend critically on the cost of doing business in a country. This includes a competitive exchange rate (which Chile has maintained, but Pakistan does not have), and a tax system that does not add to the costs of production and export. As described in the companion G-24 paper on taxation, China has just integrated its VAT on goods and services to reduce costs and make it easier to determine and automatically give VAT refunds on exports (Ahmad, G-24, 2017). India, too, is moving in the same direction with a constitutional amendment and policies to improve common economic space. Pakistan has moved in the opposite direction by splitting the VAT base between levels of government. Attempts at integration with Chinese and Middle Eastern markets now depend on Special Economic Zones (SEZs). However, as seen with the Mexican maquiladoras, while the SEZs can be useful in developing agglomeration economies, they can become a source for cheating and rent-seeking, with minimal linkages to the rest of the economy, especially if VAT exemptions are provided (see Ahmad, 2017a).

Of course, true convergence is established only if the private sector responds effectively as production costs for producers are reduced with improvement in connectivity. Typically, measures to reduce the cost-differential would be accompanied by taxes and regulations that create incentives to move out of congested and polluted areas. Own-taxes, over which a jurisdiction has control of rates at the margin, provide the basis for local or regional access to credit to finance the complementary investments needed for functional connectivity and hubs.

IV. Economy-wide Shadow Prices for Investment in Chile

The use of economy-wide shadow prices in the context of the theory of reform suggests a very different pattern of public investment for Chile, making better use of her abundant natural and human resources to generate sustainable investment opportunities. This is in line with the suggested diversification of the economy indicated by the Hausman complexity analysis. However, the precise formulation is seen to be a function of the inequality aversion preferences of the policy makers.

1. Applying the Theory of Reform

The theory of reform (see Ahmad and Stern, 1984 and 1991) and Drèze and Stern (1987) focuses on the welfare-enhancing reform possibilities of changing taxes/public prices or public supplies/investments. This involves evaluating the direct and indirect effects on households under different circumstances, as well as on producers. The method focuses on aggregate demand and supply responses, and is consequently less demanding on data and computational requirements than estimating an “optimal” solution.

The shadow price represents the increase in the value of social welfare function when an extra unit of public output is available (the social opportunity cost). The total effect on welfare can be seen as the direct change in welfare plus the change in shadow revenue, representing the general equilibrium adjustments associated with the reform. This method can be used in a broad set of applications and, for this case, include tax reforms as shown by Ahmad and Stern (1984). It also permits specification of preferences among different states of the economy reflecting valuations of environmental costs, as well as distributional characteristics.

Using a generalization of the Little-Mirrlees method, we can estimate economy-wide shadow prices based on inter-industry effects using input-output tables. The resulting sets of accounting ratios generate a range of estimates of social profitability for alternative assumptions concerning land, labor, and capital for three classes of sectors — tradeables, which comprise importables and exportables, and non-tradeables.

In addition, economy-wide accounting ratios provide directions for tax reform, giving policymakers a tool that links government revenues and the effects of consumption and production patterns, and generates incentives for good governance. Economy-wide shadow prices also require an equalization transfer framework to facilitate effective local service delivery in the new growth hubs.

In sum, the investment for SDG attainment requires:

- Market prices to be converted to the shadow prices needed to assess sectoral social profitability. The method extends that based on Little and Mirrlees (1974); and
- The corresponding changes in taxes/relative prices that might be needed to generate and support welfare-improving structural reforms evaluated according to estimates of household responses (complete demand systems, such as ELES, or Deatons' Almost Ideal Demand System).

2. The Current SNI

Chile's national system of investment appraisal, SNI, vets all public projects. The SNI performs well against the investment criteria of the IFIs outlined above (see World Bank, 2007). However, the project selection methods are based largely on market criteria (see Table 1), including interest rates and accounting ratios that do not take adequate account of externalities or inequalities. There has been an attempt to incorporate the cost of carbon emissions, but without full economy-wide implications.

It is not surprising that market-based criteria lead to a concentration of activities in the most profitable sectors and in regions that are well endowed with connectivity and public services. The public investment complements private-sector activities in the more advanced regions, leading to the migration to the metropolitan areas and greater inequality in employment opportunities and incomes, as well as in the access to public services as pointed out above.

The Hausman complexity analysis for Chile suggests the need for diversification but does not clarify what sectors should be pursued or where, or the role of public policy in achieving this. We focus here on the role of economy-wide shadow prices, drawing on Ahmad and Viscarra (2016) and follow-up work with the SNI supported by the Inter-American Development Bank.

Table 1: SNI Project Selection Parameters

Goods/Inputs	Conversion Factor
Social discount rate	6% per year (8% and 12% in previous years)
Exchange rate	1.01
Emissions (CO ₂)	2.213 pesos per ton of equivalent carbon emission
Land	Market value (without any correction)
Domestic goods and inputs	Market value – VAT
Importable materials	(Market value – Duties) × currency conversion factor
Fuels	Depends on the type of fuel and vehicle
High-skill labor	Market value × factor of conversion for high-skilled labor (0.98)
Medium-skill labor	Market value × factor of conversion for medium-skill labor (0.68)
Low-skill labor	Market value × factor of conversion for low-skilled labor (0.62)
General expenses and profits	Market value – VAT

Source: Ahmad and Viscarra, 2016.

3. Improving the SNI by Closer Linkage with a Sustainable Investment Strategy

We draw here on work with the SNI to make the investment system more reflective of the sustainable development and climate change agenda that both the current Bachelet Administration and its predecessor have subscribed to (see Ahmad and Viscarra, 2016). Project choices and tax/public pricing decisions are inextricably linked, and this is seen most clearly with environmental concerns and income distribution.

In principle, there are a multitude of shadow prices corresponding to various assumptions about traded — importables (IM) or exportables (EX) — and non-traded goods (NT), the

marginal social cost of public funds, and the accounting ratios for different types of labor, capital, and land.

Ahmad and Viscarra (2016) illustrate the method of economy-wide shadow prices for Chile and examine a number of permutations in the key variables (some of the variance in Accounting Ratios (ARs) is reported in Table 2 for a set of scenarios based on assumptions concerning sectors (IM, EX, and NT) and factor inputs.

Table 2: Accounting Ratios, Sensitivity Analysis

Groups	Class	K=0.81			K=0.5			K=0.25		
		L=0.37 M=0.40 H=0.70	L=0.62 M=0.68 H=0.98	L=0.87 M=0.90 H=1.00	L=0.37 M=0.4 H=0.7	L=0.62 M=0.68 H=0.98	L=0.87 M=0.90 H=1.00	L=0.37 M=0.40 H=0.70	L=0.62 M=0.68 H=0.98	L=0.87 M=0.93 H=1.00
Flour, pasta, cereals	IM	0.986	0.986	0.986	0.986	0.986	0.986	0.986	0.986	0.986
Vegetables	EX	0.934	0.929	0.929	0.935	0.931	0.93	0.936	0.932	0.932
Fruits	EX	0.541	0.538	0.537	0.542	0.539	0.539	0.543	0.54	0.539
Meats, sausages	IM	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988
Dairy products, cheese, eggs	NT	0.988	1.134	1.208	0.954	1.074	1.174	0.927	1.047	1.147
Edible oils, fats	IM	0.987	0.987	0.987	0.987	0.987	0.987	0.987	0.987	0.987
Fish, crustaceans, mollusks	EX	0.985	0.982	0.981	0.986	0.983	0.982	0.987	0.984	0.983
Animal feed	NT	0.635	0.755	0.86	0.611	0.73	0.836	0.591	0.711	0.816
Fuels	IM	0.991	0.991	0.991	0.991	0.991	0.991	0.991	0.991	0.991
Other food products	IM	0.977	0.977	0.977	0.977	0.977	0.977	0.977	0.977	0.977
Liquor**	EX	0.961	0.953	0.952	0.965	0.956	0.955	0.967	0.958	0.957
Non-alcoholic beverages (c)	NT	0.550	0.661	0.682	0.513	0.625	0.645	0.484	0.595	0.616
Tobacco	NT	0.464	0.556	0.585	0.437	0.529	0.558	0.415	0.507	0.536
Textiles, clothing, footwear	IM	0.982	0.982	0.982	0.982	0.982	0.982	0.982	0.982	0.982
Material for conservation, repair of dwelling	IM	0.949	0.949	0.949	0.949	0.949	0.949	0.949	0.949	0.949
Stationery, office supplies	EX	0.975	0.969	0.968	0.977	0.971	0.97	0.978	0.973	0.972
Printing, publishing	NT	0.653	0.846	1.014	0.63	0.823	0.991	0.611	0.805	0.973
Pharmaceutical products	NT	0.678	0.856	0.888	0.652	0.829	0.861	0.631	0.808	0.84
Toiletries, cosmetics	NT	0.847	1.064	1.098	0.827	1.044	1.078	0.811	1.028	1.062
Glassware, crystal; tableware, household utensils	NT	0.535	0.639	0.65	0.498	0.602	0.613	0.468	0.572	0.583
Electronic artifacts, large size tools, equipment for the household	NT	0.664	0.83	0.853	0.644	0.81	0.833	0.627	0.794	0.817
Electronic artifacts, small size tools, equipment for the household	NT	0.692	0.853	0.87	0.675	0.837	0.853	0.662	0.824	0.84
Furniture	NT	0.655	0.847	1.012	0.592	0.785	0.95	0.542	0.735	0.899
Other electronic artifacts, tools, equipment for the household	NT	0.563	0.686	0.793	0.54	0.662	0.77	0.521	0.644	0.751
Electricity	NT	1.051	1.111	1.121	0.784	0.845	0.855	0.569	0.63	0.64
Gas supply	IM	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995
Basic public services (b)	NT	1.043	1.248	1.27	0.896	1.100	1.122	0.776	0.981	1.003
Repair of household goods	NT	0.732	0.936	0.969	0.71	0.913	0.946	0.691	0.894	0.927
Hotels, restaurants	NT	1.036	1.232	1.389	0.999	1.193	1.352	0.968	1.163	1.321
Transportation	NT	0.645	0.79	0.811	0.593	0.738	0.759	0.55	0.696	0.717

Groups	Class	K=0.81			K=0.5			K=0.25		
		L=0.37 M=0.40 H=0.70	L=0.62 M=0.68 H=0.98	L=0.87 M=0.90 H=1.00	L=0.37 M=0.4 H=0.7	L=0.62 M=0.68 H=0.98	L=0.87 M=0.90 H=1.00	L=0.37 M=0.40 H=0.70	L=0.62 M=0.68 H=0.98	L=0.87 M=0.93 H=1.00
Mail, courier services (b)	NT	0.541	0.758	0.938	0.509	0.725	0.905	0.482	0.699	0.879
Telephone services	NT	0.877	1.026	1.059	0.72	0.868	0.902	0.593	0.741	0.775
Financial services	NT	0.41	0.525	0.539	0.386	0.501	0.516	0.367	0.482	0.497
Assurance, reinsurance services	NT	0.706	0.893	0.918	0.651	0.838	0.863	0.607	0.794	0.819
Services to companies	NT	0.570	0.709	0.728	0.518	0.656	0.675	0.475	0.614	0.633
Rents (apartments, houses) (b)	NT	1.026	1.031	1.032	0.702	0.708	0.708	0.441	0.446	0.447
Education (b)	NT	0.820	1.066	1.091	0.793	1.039	1.064	0.772	1.018	1.043
Medical, health services (b)	NT	0.768	0.985	1.011	0.735	0.952	0.978	0.708	0.926	0.952
Entertainment (b)	NT	0.673	0.911	1.121	0.621	0.859	1.069	0.579	0.817	1.027
Other services	NT	0.217	0.282	0.336	0.191	0.256	0.31	0.17	0.235	0.288
Mining	EX	0.981	0.976	0.976	0.982	0.978	0.977	0.983	0.979	0.978
Construction	NT	0.563	0.713	0.845	0.543	0.693	0.824	0.526	0.676	0.807
Commerce	NT	0.553	0.734	0.87	0.518	0.699	0.834	0.489	0.67	0.806
Chemical industry	IM	0.989	0.989	0.989	0.989	0.989	0.989	0.989	0.989	0.989
Basic industry metals	EX	0.974	0.97	0.969	0.976	0.972	0.971	0.977	0.973	0.972

L = low-skilled labor; M = medium-skilled labor; H = high-skilled labor, K = capital.

IM = importable sectors; EX = exportable sectors; NT = non-tradable sectors.

Source: Ahmad and Viscarra, 2016. Calculations based on the input-output matrix 2008, Central Bank of Chile.

It is clear from Table 2 that the precise assumptions used depend on the resulting sectoral accounting ratios, and hence the choice and rankings of the projects chosen. While there are clear differences across the sets of assumptions, the general pattern emerging from the simulations is that the highest accounting ratios are for the higher linkage (especially in terms of potential employment generation) and higher value-added sectors. This is consistent with the Hausman et al. complexity analysis for Chile that suggests the importance of diversification. The economy-wide shadow prices indicate priorities for public action. This is also reflected in the corresponding social profitability exercise (Table 3).

Interestingly, sensitivity to various levels of a “carbon tax” does not change the social profitability of sectors, but results in changes in the accounting ratios for each set of assumptions.¹¹ Thus, while diversification is still a goal, this can be achieved by “cleaner” and less carbon intensive projects. However, the overall recommendation for diversification for more sustainable employment generation remains robust.

Many of the parameters offered among the wide range of shadow prices will be determined by the government’s medium-term macro-fiscal or sustainable growth strategy. This will help to fix

¹¹ Simulations carried out at the request of SNI and available on request.

the key assumptions to be used in the project selection process, including the choice of the social discount rate. Specifically, in the Chilean context, this will involve DIPRES, responsible for macroeconomic policy in the Ministry of Finance, as well as the SNI.

Table 3: Social Profitability of Different Sectors in Chile

Groups	K=0.81 (A1)			K=0.5 (A2)			K=0.25 (A3)		
	L=0.37 M=0.43 H=0.73	L=0.62 M=0.68 H=0.98	L=0.87 M=0.93 H=1	L=0.37 M=0.43 H=0.73	L=0.62 M=0.68 H=0.98	L=0.87 M=0.93 H=1	L=0.37 M=0.43 H=0.73	L=0.62 M=0.68 H=0.98	L=0.87 M=0.93 H=1
Flour, pasta, cereals	0.404	0.409	0.321	0.435	0.445	0.351	0.459	0.470	0.376
Vegetables	0.395	0.380	0.316	0.430	0.426	0.351	0.458	0.454	0.379
Fruits	-0.030	-0.089	-0.317	0.046	0.006	-0.240	0.108	0.067	-0.178
Meats, sausages	0.255	0.260	0.182	0.280	0.299	0.207	0.301	0.320	0.227
Oils, fats	0.354	0.355	0.311	0.368	0.369	0.325	0.379	0.380	0.336
Fish, crustaceans, mollusks	0.228	0.242	0.154	0.244	0.257	0.170	0.257	0.270	0.183
Fuels	0.847	0.852	0.837	0.864	0.869	0.854	0.877	0.882	0.868
Other food products	0.523	0.535	0.461	0.546	0.557	0.482	0.563	0.574	0.499
Liquor	0.474	0.505	0.416	0.503	0.533	0.445	0.526	0.556	0.468
Textiles, clothing, footwear	0.494	0.497	0.385	0.523	0.527	0.414	0.547	0.550	0.438
Material for conservation, repair of dwelling	0.451	0.460	0.383	0.479	0.488	0.411	0.502	0.510	0.433
Stationery, office supplies	0.478	0.502	0.398	0.514	0.538	0.435	0.544	0.567	0.465
Mining	0.538	0.545	0.512	0.596	0.603	0.569	0.643	0.649	0.616
Chemical industry	0.527	0.539	0.505	0.568	0.580	0.547	0.601	0.613	0.586
Basic industry metals	0.491	0.496	0.455	0.509	0.513	0.472	0.523	0.527	0.493

Source: Ahmad and Viscarra, 2016. A number of simulations were carried out with alternative assumptions about the tradable and non-tradable sectors.

Of course, the SNI could make assumptions only about the key parameters without reference to DIPRES. This will have a major impact on the growth strategy and outcomes that differ from the macro-economic priorities of DIPRES. This highlights the importance of the coordination and governance issues in making public investment decisions, and the need to link these to an agreed sustainable growth strategy that also addresses the “middle-income trap”. Greater precision is needed, especially with respect to tax policy at the national and subnational levels, and how this links to the investment structural reform priorities.

Ahmad and Viscarra (2016) use the theory of reform to complete the policy analysis associated with a sustainable investment strategy. This evaluates the social marginal cost of raising a peso/\$ on firms (through the shadow prices) and households (using a household income and expenditure survey), and are evaluated using complete demand systems (estimated by Ahmad and Viscarra, 2016) and estimated for various degrees of inequality aversion using a value of an

Atkinson index, ε of 0 (that approximates the current SNI weights — a peso to the poorest is evaluated as the same as a peso to the richest group in the country); and ranging to an Atkinson index of $\varepsilon = 5$ that puts almost all the weight on the lowest groups of the population. Rankings of the social marginal cost for various levels of ε are shown in Table 4.

Table 4: Social Marginal Cost Ranking for Various Inequality Parameters in Chile

Groups	$e=0$	$e=0.5$	$e=1$	$e=2$	$e=5$
Rents (houses, apartments)	1	1	1	1	1
Transportation	2	3	15	21	19
Other services	3	17	24	24	24
Education	4	23	25	25	25
Telephone services	5	16	22	23	23
Hotels, restaurants	6	11	16	18	18
Textiles, clothing, footwear	7	7	12	14	8
Health	8	13	18	16	10
Meats, sausages	9	5	4	6	9
Public basic services	10	2	2	2	2
Financial services	11	14	17	15	14
Flour, pasta, cereals	12	6	5	17	17
Entertainment	13	26	26	26	27
Electricity	14	4	3	5	7
Vegetables	15	9	11	12	15
Non-alcoholic beverages	16	8	7	7	6
Pharmaceutical products	17	21	21	20	20
Dairy products, cheese, eggs	18	10	10	11	13
Other food products	19	19	20	19	22
Gas	20	12	8	10	12
Liquor	21	15	6	3	3
Fruits	22	18	13	8	5
Tobacco	23	25	23	22	21
Toiletries, cosmetics	24	27	27	27	26
Fish, crustaceans, mollusks	25	20	9	4	4
Oils, fats	26	22	14	9	16
Fuels	27	24	19	13	11

Source: Ahmad and Viscarra, 2106. Note: 1 is the highest-ranked social cost, and also the least attractive to tax; 27 is the lowest-ranked, and most attractive for raising an additional dollar in revenue.

Details of the directions of reform are explained in Ahmad and Viscarra (2016). For our purposes, we illustrate how the method would work in practice. The basis of the tax system would be a VAT on all transactions that generate production efficiency — business-to-business transactions are credited, and exports are zero-rated (all tax on earlier stages removed).

The required differentiation for, say, tobacco and cosmetics, could come through additional excises, or in the case of fuels, a carbon tax. As seen in the first column of Table 4, “Fuels” is the most attractive sector for additional taxation. The rankings change as the Atkinson index increases, as even the poor consume fuels. However, from a sustainable development perspective, one would still want to tax carbon-generating products, and some compensation

for the poor needs to be sought. The approach differs in the case of “Public basic services”, which are among the least attractive sectors to tax for virtually all levels of inequality aversion (this issue is discussed further in Ahmad, 2017, G-24 paper). The importance of housing and basic public services meshes nicely with the issue of which level of government should be responsible for providing these services, especially with regard to sustainable local “hubs”.

V. Overlapping Models, Policy, and Further Work

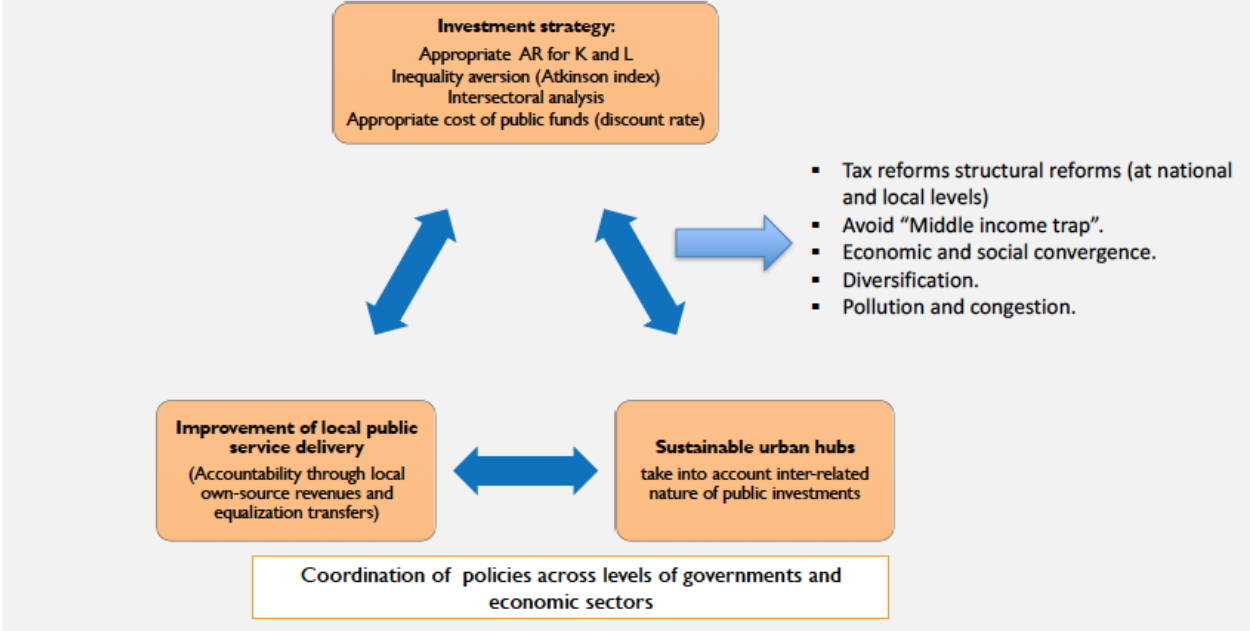
The Chilean example illustrates that while the application of the fairly sensible IFI investment guidelines is beneficial, it is not necessarily sufficient for ensuring sustainable generation of employment opportunities, or inclusive growth. Chile has displayed “prudent macroeconomic management” over two decades, but the growth pattern has created greater reliance on primary exports, or Dutch Disease, with symptoms of an emerging middle-income trap, with concerns about employment opportunities for an increasingly vocal and educated work force. And, as highlighted by the post-2008 economic crisis, the economy faces increased vulnerability due to fluctuations in demand for its primary products. There has also been a buildup of congestion and pollution in the metropolitan area, as well as very high levels of inequality.

A useful starting point for the public investment agenda is a long-term strategy for sustainable growth. This involves, for instance, utilizing dynamic spatial models, and the effective utilization of natural resources, skills, and markets to develop clean cities as growth “hubs”. Both national and cross-border connectivity play a role in changing cost structures that govern the location of private investment and activity. As seen in Chile, and in China, connectivity per se is not sufficient to induce a shift in activity from, say, the coastal metropolitan areas to the less affluent interior provinces in China, or *zonas rezagadas* in Chile. However, the aggregate spatial models provide useful information and parameters for the choice of groups of infrastructure projects within and across levels of government.

The investment choices should reflect the macroeconomic parameters, consistent with a sustainable growth strategy for the whole economy (see Chart 12). This includes the government’s degree of inequality aversion, treatment of different types of labor and capital,

as well as any premium on foreign exchange (not an issue in Chile, as the exchange rate is market determined). A critical issue is the choice of discount rate — and for sustainable development within a social cost-benefit framework, which should reflect the cost of raising public funds, and not the relatively high market rate of interest used in the SNI.

Chart 12: Investment and Multilevel Taxation Linkages



Another critical macroeconomic issue on which further work is needed is whether a fiscal rule might be amended to allow for public investment, as argued by Lin and Wang (2016) if faster growth results in the medium-term. Also, given a certain stock of debt and a deficit limit, the apportionment of a general government limit among levels of government needs to be thought through, given the ability to pay of each administration over time. This is critically linked to own-sources of revenue (over which the jurisdiction has some control, especially in relation to setting rates at the margin (see Ambrosanio and Bordignon, 2015). In the absence of own-sources of revenue — e.g., with a system of shared revenues and central transfers, a subnational government (SNG) is unable to raise additional revenues to meet future liabilities and the effective responsibility shifts to the center, with a concomitant absence of a credible hard budget constraint. A key issue is whether the same limit should apply to SNGs or whether growth hubs might be permitted a higher limit.

Coordination among levels of government is critical for the “loop” in Chart 12 to operate — with policies at the central/federal level being even across the country, including key parameters and the tax system and national investments, with the necessary criteria for growth hubs/clean cities, and the local tax and complementary investments needed to make the strategy work.

The central/federal government has to address national connectivity issues, as well as any cross-border programs (the supranational EU structural funds focused on connectivity in the less well-developed regions, with partial success at best—see Ahmad, Bordignon and Brosio, 2016). The issues are clear in large, multilevel unitary states such as China and Indonesia, where national legislatures have the power to pass laws that affect all levels of government, but the centers lack information or ability to undertake projects at local levels that would have the greatest impact on sustainability. Yet, only the center can devise and finance strategies that lead to a shift in costs and effective “distance” through the creation of hubs and new trading linkages. The issue is even more acute in federal countries, such as India and Pakistan, or indeed the US, where state/provincial or local decisions are critical. Given the constitutional provisions in the US, coordinated actions at the state and local level concerning sustainable growth can offset inactions at the federal level. However, this may be harder to achieve in other countries, although there are lessons from the US to the rest of the world, and vice versa, that form part of an active research agenda.

Shadow prices yields both welfare-improving directions for additional investment as well as tax reform. The issues are seen clearly with respect to the tax agenda and assignments, and are addressed in the companion G-24 paper (Ahmad, 2017), along with a corresponding research agenda. A few points need to be highlighted in the context of the sustainable investment discussion:

- 1. Investment priorities should be supplemented with a national tax policy framework.**

Ahmad (2017) identifies both a VAT and a carbon tax as elements that provide financing, reduce distortions, and create the right incentives for public action. China completed full integration of the VAT on goods and services in 2016 to reduce the costs of doing

business. India is trying to do the same with a recently-passed constitutional amendment. However, consolidation of sales tax bases into VAT reduces the instruments available to subnational governments.

2. **The national tax agenda needs to be supplemented by a local tax system.** As in the case of China, or South Asia, a higher carbon tax might be justified in the metropolitan areas that are subject to congestion and pollution. This could be achieved with a piggy-back on the national tax (Ahmad and Stern, 2011). Similar considerations apply with respect to a piggy-back on the income tax that could provide own-source revenues without the need for separate administrations.
3. **The need for a local tax system, even if relatively small in overall revenues, is quite significant** to generate incentives for firms and workers, and more importantly to create hard-budget constraints for local governments. The property tax does not function well at the local level in most emerging-market economies, so it is important to generate alternative mechanisms to develop sustainable investments in for such emerging markets (see Ahmad, Brosio, and Pöschl, 2015; Ahmad, Brosio, and Gerbrandy, 2017 for an assessment of property taxes with regard to SDGs, with application to Senegal and Tanzania, and supplements discussion of Latin American and South Asian cases).
4. **Own-source revenues are needed at the local level also to anchor local access to credit.** Without some local control over rates — e.g., within a band set by the national legislature in unitary countries (see Ahmad, 2017b, for a discussion of China) — **it would be highly premature to create a local bond market, although this would be very helpful in due course.**

An increasing reliance on PPPs — e.g., in China — underlines the importance of the own-source tax issues, as public liabilities are generated, with considerable potential for game-play and rent-seeking in a multilevel context. These issues are discussed further in the companion G-24 paper Ahmad, Vinella, and Xiao (2017).

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