

Infrastructure: A survey of recent and upcoming issues

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**Infrastructure Vice-Presidency, and
Poverty Reduction and Economic Management Vice-Presidency**

April 2006 (version 2.0)

Abstract

This paper surveys the recent academic empirical economic literature on the main current infrastructure policy issues in developing and transition economies--infrastructure is defined here as all the facilities used to deliver energy, water and sanitation, telecommunication and transport services. The survey tries to provide an unbiased coverage of the discussions on the linkages between infrastructure and, respectively, institutions, growth, equity, finance and corruption. The bulk of the analytical evidence draws on quantitative analytical assessments of the key lessons on these interactions from the 1990s and of the early part of the 2000s. In the process, the paper provides a rough blue print for a research agenda on infrastructure since one of the main overarching lessons is that the knowledge gap is not a small one.

The main policy conclusions of the paper can be summarized as follows. First, the data gaps are so large that they impede an effective monitoring of the evolution of performance in terms of access, efficiency, equity or fiscal costs for most sub-sectors. As a consequence, there is less global accountability in this sector than in health or education. Governments should spend as much time benchmarking and assessing the performance of public operators as they do or would do for private operators to increase the accountability of the sector and minimize costs to the users and the taxpayers. Second, the debate on the growth relevance of infrastructure shows that investment planning and policy coordination in infrastructure or improvements in the assessment of the sectoral dimensions of fiscal sustainability analysis are not “text-bookish” concerns of the past, they are still essential to avoid bottlenecks slowing down national and/or regional growth or distorting urban vs. rural resource allocation decisions. Third, the experience of the last 15 years shows that most countries will be better off working out a partnership with the private sector to achieve sustained efficiency gains and minimize fiscal financing requirements. However, not every sector of every country has been or will be able to achieve this. Moreover, even when these partnerships will be possible, the main responsibility for financing many of the investment needs will fall onto the taxpayers rather than the residential users, at least in capital intensive transport and water and sanitation. Fourth, the recent experience also shows that to ensure the sustainability of reforms and to ensure the fair distribution of their gains, possible trade-offs between efficiency and equity need to be diagnosed very early on in the reform process—and the tools to do so are available, they are simply not used as widely as they are in other sectors such as education or health. Fifth, the research on poverty shows that if there is a political will to address the infrastructure needs of the poor in the short to medium run and if the country can’t generate the tax revenue to finance well targeted direct subsidies, well targeted inter-user, inter-usage or inter-regional cross-subsidies can deliver. Finally, the research on corruption shows that there is no simple institutional solution to reduce its impact in the sector. Based on the evidence available so far, the international infrastructure community does not yet have strong specific recommendations, besides the obvious ones on the need to generate information to increase accountability. This may be the main new area for research emerging from this survey because it touches on all the dimensions of infrastructure policymaking.

¹ I am grateful to F. Bourguignon, J.J. Dethier, M. Fay, A. Goicoechea, M. Kerf, C. Kessides, M. Khalil, L. Lovei, M. Monteliu, J. Narkevic, M.-Y. Pleissis-Fraissard, J. Saghir, K. Sierra, M. Torero, L. Trujillo, Q. Wodon and two anonymous reviewers for useful feedbacks on an earlier version. The views expressed in this paper are my own and should not be attributed to the World Bank, its affiliated organizations, its board or the governments they represent. Any mistake or misinterpretation of facts is my responsibility.

1. Introduction

Infrastructure seems to be returning to the agenda of development economists!² This follows the recent return of infrastructure to the top of the agenda for many governments and donors. After roughly 10 years of a relatively modest profile, this “born again” policy and academic interest in infrastructure should not really be a surprise.³ Access to affordable infrastructure services continues to be rationed for a large share of the poorest populations of the world. In Africa, for instance, increases in water and energy networked services have roughly only managed to catch up with population growth during the 1990s and coverage still is the lowest in the world, in particular for the lowest income classes.

Moreover, growth is so obviously constrained by infrastructure bottlenecks in a wide range of developing countries that governments are not really surprised when they get the results of investment climate surveys telling them that they should rank infrastructure as a top priority. The poorest countries need to spend about 9% of their GDP on operation, maintenance and expansion of their infrastructure if they are to reach the MDGs. They are now probably spending about half of that, although we do not know because nobody is really measuring the allocation of public resources to the various sectors properly.

More surprising may be the diversity of lessons that governments and donors have learned over the last 10-15 years on what matters for the operation, regulation, financing and political management of infrastructure services. Besides the more specific lessons discussed below, the most dramatic lesson the international infrastructure community may have learned is humility. This is because we have collectively found the limits of our knowledge on a wide variety of issues relevant to policymaking in infrastructure.

There is, for instance, still a lot of uncertainty on how, and how much, infrastructure impacts growth. Does it work in the same way at all stages of development, for all regions in the same country, for rural and urban areas? There is probably even more uncertainty on many fiscal dimensions relevant to the sector. How and how much did reforms really change the fiscal cost of infrastructure in the aggregate and across government levels? Are standard fiscal rules used to assess debt sustainability penalizing the sector unnecessarily? Can the public sector deliver the services without the private sector? To a large extent, these issues are related to our weak understanding of the actual relevance of institutional reforms. For instance, are regulatory agencies really needed? If yes, do they need to be independent? Can we build a reform on institutional models mixing Anglo-Saxon and other legal traditions? What kind of institutional reforms are needed to improve accountability and eradicate corruption in this sector? Finally, there is still a lot we don't know about the infrastructure-poverty nexus simply because we don't

² The concept of infrastructure has a wide range of definitions in the literature. In this paper, infrastructure means all the facilities used to deliver energy, water and sanitation, telecommunication and transport services. I do not deal with irrigation even if I am convinced that it is an essential dimension of the management of the water sector.

³ Last time the academic world got massively interested on infrastructure was a debate initiated by the 1989 Aschauer paper on the importance of public capital in the US.

have a good baseline on how much the poor actually spend and consume on infrastructure services.

This paper sums up the key lessons on these issues from the 1990s and of the early part of the 2000s. It relies mostly on recently published research but also on some current yet unpublished research. In the process, the paper provides a rough blue print for a research agenda on infrastructure since one of the main overarching lessons is that the knowledge gap is not a small one.

The paper is organized as follows. Section 2 provides a snapshot of the main dimensions of the sector. Section 3 summarizes some of the questions emerging on the linkages between infrastructure and growth. Section 4 goes through the evidence on the relevance of infrastructure for the poor. Section 5 summarizes the main debates on the fiscal cost of the sector and on the potential for a private sector role in the sector. Section 6 deals with corruption. Section 7 concludes.

2. The state of the infrastructure sectors

Contrary to a widespread impression among casual observers of the sector, a large proportion of infrastructure services are still mainly delivered by the state in many countries of the world. The relative importance of the private sector has significantly increased in some sectors but the public sector continues to finance and often also deliver many of the services. Many governments faced with fiscal constraints did try to cut their financing role in the sector during much of the 1990s but not many really succeeded in attracting the private sector and, where they succeeded, the record has been on average mixed.⁴

Table 1 summarizes the results of a recent survey on the extent to which the large scale private sector was making some significant contribution to the financing of various infrastructure subsectors in 2004 (2002 for rail) in developing countries. As expected, the interest of the private sector is highest for the highest income countries. Less expected maybe is the fact that the large scale private sector's presence is much less widespread than sometimes argued.⁵ Roughly only one third of the developing countries can count on these operators for the delivery of electricity, water, or railways services. The largest presence is in the fixed line telecoms business where about 60% of the countries rely on private operators. Overall, the private sector has roughly contributed to 20-25% of the investment realized in developing countries on average over the last 15 years or so.⁶ In Africa, it has probably contributed less than 10% of the needs.

⁴ Roughly a third of the countries enjoy some significant private participation in water and sanitation and electricity distribution and about 50% in fixed line telephony. For more details see Estache and Goicoechea (2005).

⁵ This is not to deny the presence of the private sector. In fact, where the state and the large private sector has failed to deliver the services, the small scale, generally local, private sector has filled the gap. The evidence on their role, and details of their costs, is however mostly anecdotal.

⁶ This estimate has been made independently by researchers at DFID and the World Bank. Very roughly, it has been worked out as follows. The international community has some sense of the physical capital stocks per country and can hence value them at constant prices. The changes in these stock values give a sense of the total investment in the sectors. The contribution of the private sector to that investment is given by the

Table 1: Countries with Private Capital (% of sample)					
	Electricity Generation 2004	Electricity Distribution 2004	Water & Sanitation 2004	Rails 2002	Fixed line Telecoms 2004
Low Income	41%	29%	18%	34%	50%
Lower-Middle Income	48%	37%	50%	26%	62%
Upper-Middle Income	58%	48%	47%	60%	72%
Developing	47%	36%	35%	36%	59%

Source: Estache and Goicoechea (2005)

To many countries, in particular the poorest countries, this low interest has been a significant disappointment. Indeed, many of the countries followed the prescriptions of the “specialists” in order to attract the private sector. They unbundled their services, introduced competition where they could (in and for the market) and created independent regulatory agencies. This did not really help. Consider Table 2 which reports the percentage of countries which have created an “independent” regulatory agency.⁷

Comparing Table 2 with Table 1 implies that having an independent regulatory agency, one of the main policy recommendation in infrastructure of the last 10-15 years, does not guarantee private participation. Indeed, there are more countries with such agencies than countries with private participation in electricity distribution. On the other hand, a country does not need an agency to attract the private sector. There are more countries with private participation in water or rail than countries with independent regulators in those sectors.

Table 2: Countries with Independent Regulatory Agencies (% of sample)				
	Electricity 2004	Water & Sanitation 2004	Rails 2002	Fixed line Telecoms 2004
Low Income	38%	13%	2%	69%
Lower-Middle Income	63%	32%	8%	60%
Upper-Middle Income	63%	28%	19%	71%
Developing	51%	22%	8%	66%

Source: Estache and Goicoechea (2005)

The apparent paradox between Tables 1 and 2 is not really the case. The participation of the private sector depends on many more dimensions than the risks associated with not having an independent regulator or having a bad regulator. Exchange rate risks, commercial risks and political instability are all forms of risks which can be just as damaging. These risks are typically accounted for in estimates of the minimum rate of return that private operators want from a deal in any given country. Ignoring for now the strategic motivations that may lead an operator to enter a country even if the returns on a specific transaction are not high, it is usually believed that estimates of the

total commitments made during the same period by the private sector according to the World Bank PPI database. This is likely to be an overestimate since commitments are not necessarily disbursed.

⁷ No countries have fully independent regulatory agencies. Often, these are agencies with some degree of autonomy from the ministry covering the sector they are responsible for. When politicians want to take over the regulatory function, they simply do as the Latin American experience of the last 3 years has clearly shown.

cost of capital associated with a transaction can be a good approximation of the expected minimum return.

A couple of recent papers estimate this cost of capital.⁸ They show why there is less private capital in lower income countries. Indeed, these estimates suggests that returns required to start a project in lower income countries have to be at least 2 to 3% points higher than in richer developing countries and more than the double of what is generally expected in developed countries in infrastructure activities.⁹ The average rate of return has actually often been below this cost of capital, in particular in Eastern Europe and in Latin America where the public sector is coming back strongly to operate utilities. The social story that needs to be read from these numbers is in fact more dramatic. It implies that, all non-financial conditions being equal, the average tariff necessary to generate the minimum required rate of return in the poorest developing countries has to be higher than elsewhere since it needs to cover a higher cost of capital. This is politically a very difficult position to argue for and fewer and fewer private operators are willing to hold it, in particular in politically sensitive sector such as water and passenger transport.

Overall, the various reform experiences have provided a number of insights on what needs to be better analyzed by researchers and where policymakers need to better focus their attention. The lessons are, however, quite diverse across regions. Latin America has probably been the most effective in showing that infrastructure matters to growth since there is quite a bit of evidence on the cost to growth of the slow down of investment in infrastructure in the region.¹⁰ There is also a growing body of evidence on infrastructure as an explanation of the gap between rich and poor regions within large countries as discussed in section 3. Most importantly maybe, Latin America's recent experience has been particularly effective in showing that we need to study the social and political risks better because they matter to the effectiveness of reforms, and hence their sustainability. Reforming by decree without an effort to build up support is no longer an option. In this region, the poor have very clearly voiced their view on what kind of infrastructure services they want.¹¹ Very often this implies that policymakers have to understand how to better balance the concern for equity with the need for incentives to invest which has dominated the last 15 years of reforms. The experience also shows that it is worth looking more carefully into the options to ensure the commitment of government and operators to increased accountability to the users and to the taxpayers. This can be achieved by the adoption of regulatory models which allow a transparent documentation between efficiency, equity and fiscal considerations.¹²

⁸ See Estache and Pinglo (2005) for all developing countries and Sirtaine et al (2005) only for Latin America.

⁹ The recent paper by Sirtaine et al. (2005) provides a very detailed analysis of the evolution of the cost of capital in Latin America and compares it to the rate of return that can be estimated from the balance sheet of the main infrastructure operators in the region.

¹⁰ See Easterly and Serven (2003) for instance.

¹¹ The rejection of the infrastructure reforms of the 1990s, in particular the increased role of the private sector in the delivery of services, did not play a minor role in the wave of political change in Argentina, Bolivia, Brazil, Venezuela or Uruguay.

¹² Indeed, reforms often have fiscal costs, often generated as part of renegotiations, which could have been anticipated if a sort of consistency frameworks documenting the sources of costs and incomes of the regulatory operators accounting for reasonable demand forecast had been adopted more widely. Of crucial

The 1990s and the 2000s so far have also shown that we don't really know yet how to address risk effectively. East Asia may have been the most effective in revealing that foreign exchange risk matters to infrastructure financing.¹³ The first generation of public private partnerships in East Asia was indeed significantly hit by the 1997 crisis. Almost 10 years later, these partnerships have not yet fully recovered in the region, with the obvious exception of China. Eastern Europe and Africa have been relatively more effective in showing that we still have a long way to go to understand how institutional reforms work in this sector. It may very well be that they have to be slow. We need to document better how counterproductive trying to force brutal institutional changes without taking the time to build the institutional capacity consistent with the desired reforms could be. For instance, the difficulties of implementing concession contracts in francophone Africa where lawyers were much more familiar with affermage contracts is a good illustration of potential problems. The importance of this risk in Africa has been significantly less well studied than the intensity and the drivers of renegotiation in general and in Latin America in particular.¹⁴

A final research agenda obviously emerging from a current diagnostic of the sector may be that there is strong anecdotal evidence now that politics matter. Experiences in Asia, Eastern Europe or Latin America show that politicians will never give up the control of a sector that buys votes in democratic societies. Moreover, in societies in which corruption is rampant, they will not give up control of a sector involving large amounts of money and in which contract award processes often provide opportunities for unchecked transactions.

There is a widespread sense among the specialists that economic regulation and regulatory processes need to be taken much more seriously by actors concerned with corruption. There is however little evidence of the direct link between corruption and lax regulation. As discussed later in the paper, evidence is starting to emerge but it is still too modest to be transformed into a strong case validating the intuition of the regulatory experts. Regulation will probably never really be independent, but much more transparency and accountability is achievable. It is worth testing more formally whether this is worth the effort and time demanded from governments busy with many other components of the reform agenda.

Improving accountability of regulators and operators will have to start with an improvement in the way the various dimensions of the sector are being measured. The international community, for instance, has very little specific knowledge of access rates, affordability, quality or fiscal cost of the sector. Most of the information necessary to ensure a minimum level of accountability from government, donors and operators is either estimated very roughly, very occasionally or often never really collected.

importance is the need to recognize that the gap between the rate of return of the business and the costs of capital will be paid by the taxpayers or by the users. It turns out that the taxpayer has been much more called upon than sometimes recognized. See Campos et al (2003) for instance on the actual fiscal cost of the sector after 10 years of reform in Latin America

¹³ Although the investors in Argentina would probably argue that the pesification of the economy implemented in January 2002 may have been the best evidence so far of what that risk means.

¹⁴ See Guasch (2003) for an overview of the issues in Latin America.

Before turning to what we know and what we need to know on each issue, it may be useful to conclude this section with a very basic quantitative snapshot of the sector. Consider this snapshot to be a baseline from which progress from reform will eventually have to be measured. The most fundamental performance baseline may be the share of the population with access to basic infrastructure services. This is reported in Table 4 for the last year for which the data are available for a large enough sample of countries. Table 4 points to a major gap between the lowest income countries and the middle income countries and shows that there is a long way to go for the development community.

Table 4: Access Rates to Utilities Services				
	ELECTRICITY (2000)	TELECOMS (2003)	WATER (2002)	SANITATION (2002)
	Access to Networked Electricity (% of population)	Telephone Subscribers per 1000 people	Access to Improved Water Sources (% of population)	Access to Sanitation (% of population)
Developing	58	290	77	59
Low	31	76	65	41
Lower-middle	82	319	85	72
Upper-middle	87	672	93	86

Source: Estache, Goicoechea and Trujillo (2006)

Table 4 hides one of the most unfortunate dimensions of the coverage gaps. Even if it shows that access to infrastructure services is highly correlated with income, it does not reflect fairly the drama of the poorest population.¹⁵ A recent note by Briceno and Klytchnikova (2006) who put together all the data available per income classes shows a much more dramatic income distribution twist. In all country groups, the 20% poorest are significantly poorer than the 20% richest and the gap is the highest for the lowest income group. Their information is summarized in Table 5

Table 5. Access to Basic Infrastructure Services (2000-04, latest observations available)								
Share of population	Electricity		Water		Sanitation		Telephone	
	Poorest 20%	Richest 20%	Poorest 20%	Richest 20%	Poorest 20%	Richest 20%	Poorest 20%	Richest 20%
LIC	9.7	68.7	41.1	78.5	27.2	68.8	3.2	24.5
LMC	79.5	99.3	64.5	86.6	48.2	78.7	21.2	66.1
UMC	81.4	99.5	76.7	95	73.4	96.4	32	73.1

*DHS and IES - Households reporting access to electricity. **JMP/WHO - Percent of population with access to an improved water source
 JMP/WHO - Percent of population with access to an improved sanitation facility *DHS/IES - Households reporting access to a telephone.
 Source: 2006 Global Monitoring Report.

Commitments to improve access rates in water and to some extent in telecoms have been picked by the MDGs. The commitments to electrification have been added as part of the Johannesburg declaration.¹⁶ There is however no similar commitment to

¹⁵ In the DHS data, the poorer and richer are defined based on an asset index used as a proxy of the welfare level. In the IES/LSMS data, households are ranked in terms of per capita total expenditures.

¹⁶ The most recent evidence however suggests that the MDGs are unlikely to be met in many countries of the world. See Global Monitoring Report (2005)

anything related to the transport sector. There is, in fact, very little information on what could be a reasonable baseline to assess the performance of the sector. Of course, we know that road density in the poorest developing countries is about a third of what it is in the richest developing countries and about a sixth of what it is in developed countries. This certainly gives a sense of the way to go but it is not very specific. In fact, most of the evidence on the relevance of the transport sector stems from macroeconomic work looking into the engine of growth as discussed in the next section.

An ideal baseline to track progress quantitatively would also include information on affordability and on the quality of services. This information is however not really available for a large majority of developing countries. Most of the information published is anecdotal and often when cross countries comparisons are available, they compare apples and oranges because the definitions for quality standards or service pricing practices vary significantly across countries.

An ideal baseline would also include information on the cost of the sector. This is particularly important in view of the size of the projects and the importance of the associated financial transactions. Comparable cost data in infrastructure are largely unknown in this sector in developing countries and this is in spite of a standard policy message which aims at telling policymakers to improve cost recovery because it costs too much to the taxpayers. In fact, we do not even know how much this sector is costing the taxpayers. The IMF Government Financial Statistics, the standard reference on public finance data, reports very little information relevant to assess the performance of the infrastructure sector.¹⁷

In sum, the experience of the last 15 years or so has shown that there is a lot of work to be done to ensure that the lessons of experience are properly internalized in the advice given to policymakers in infrastructure. This experience has also shown that the international community needs to measure performance better. This is not only to measure the degree of effectiveness of reform. It is also needed to ensure improved accountability by all actors--governments, operators, bankers and other financial actors, users and donors.

3. Infrastructure matters to growth in many ways

Since the late 1980s, over 150 published papers in English, French, or Spanish—and at least as many unpublished ones—have analyzed the macroeconomic effects of infrastructure. This is probably still the most widely covered theme in the economic literature on infrastructure, as well as the best known outside the infrastructure community. This literature boom has mainly been the result of conceptual and technical developments associated with new growth theory and associated discussions of regional policies (see de la Fuente 2002 for a survey that includes a discussion of infrastructure).

Among the most useful outcomes of this literature has been a debate on the actual importance of infrastructure spending at different stages of development. The main message from this literature seems to be that how much infrastructure spending really

¹⁷ Some countries are starting to draw their own baseline independently such as India in its very useful series of annual India Infrastructure Report series edited by 3iNetwork.

matters is an empirical matter, and that infrastructure matters more in low-income countries or in low-income regions than in richer countries.

The most common way of quantitatively assessing the effective relevance of infrastructure spending is to estimate social economic rates of return of past and new investments using a production function. Most of the academic literature estimates these returns using macroeconomic growth regressions. These are usually calculated using data for a specific country or group of countries over several years. In recent years these methods have suggested *economic* returns on investment projects averaging 30–40 percent for telecommunications, more than 40 percent for electricity generation, and more than 200 percent for roads (although, when the outliers are excluded, the average is about 80 percent for roads). Returns tend to be higher in low-income than in middle-income countries (see Canning and others 2000 and Briceño and others 2004).

New growth theory has also analyzed factors leading to the convergence—and disparities—of growth rates between poor and rich regions within and across countries. This research has generated comparative rankings of sectors across regions in the same country, showing that one size does not fit all when it comes to assessing a country's public investment needs—see de la Fuente and Vives 1995, in an analysis of Spain, for a perfect example of how creative empirics building on good theory can guide public investment decisions.

In addition, there is a specialized literature on urban and regional policies. A lot emerged from the new economic geography theory and boomed following the seminal contribution by Krugman (1991). Its basic concern is how firms decide on the locations for their production. The main tradeoff is between market proximity and production concentration, and is driven by transportation costs and economies of scale in production. In connection with this theory, there is also a (re)-emergence of the concept of territorial planning with a view to direct expenditures on the basis of territorial priorities instead of sectoral priorities. But many other factors are also relevant, causing this literature to develop at an amazing pace—see Baldwin and others 2003 for a recent overview, including a chapter on the relevance of infrastructure for effective regional policies. The upshot at this stage may be that while theory points to a significant potential role for infrastructure, in particular transport, in creating or closing growth wedges between regions, there is a need to collect a lot more empirical evidence than we currently have.

Finally, a large share of the literature on the importance of growth also discusses whether priority should be given to support rural or urban development. This may in fact be the most important area of new research in the forthcoming future.¹⁸ This is very closely related to the debate on rural vs. urban poverty. Because rural poor people live in relatively low-density areas and rely heavily on natural resource-based production, their demands for infrastructure are quite different from those of the urban poor.¹⁹ Both groups

¹⁸ The minimum population threshold for defining urban areas varies dramatically among countries, but “urban” is typically characterized by density of settlement in a contiguously built-up area, by the structure of economic activity, and sometimes by administrative attributes.

¹⁹ Diversification of income sources is a key component of rural poverty reduction strategies, and one that depends on infrastructure to be effective (see Ellis (1998) for a survey). In a survey of the literature identifying a poverty trap similar to the one observed in regions with large rural populations, as in Africa, Booth (2004) lists eight factors used by all authors to explain poverty that is mostly rural in those regions.

tend to have limited access to public infrastructure and services, but the constraints on physical access to job and product markets are bigger concerns for the rural poor (see for instance the case studies by Fan and his various co-authors on China, Thailand or Uganda or see van de Walle and Cratty 2004 for recent detailed studies). For the urban poor, recent household surveys seem to indicate that what the poor are being asked to pay for their infrastructure services provided by utilities is often creates an affordability barrier. At the same time, access by the rural poor to network utilities is less important because many prefer more cost-effective local solutions for their needs—such as solar energy, water pumps, and satellite-based telecommunications. In the context of urbanization, the growth of large cities is fast becoming a major source of demand for additional infrastructure, creating a sense of urgency in some policy circles.²⁰ But this sense of urgency is criticized by some academics as favoring an excessive urban concentration (Henderson, 2002). There is indeed a hot debate—mostly around the effects of investment in inter-regional transport—as to whether new infrastructure also creates additional incentives for rural-urban migration. The debate is, in fact, as hot as the evidence provided by both sides of the debate is scarce. Most of the discussion is based on case studies but there is, to my knowledge, no technical analysis of the phenomenon.

4. How can we make sure that the poor are being served?

In just the past four years international organizations, bilateral agencies, and think tanks have produced seven major books on how infrastructure reforms affect poor people (Estache and others 2002 on Latin America for the World Bank; Ugaz and Waddams-Price 2003 on Latin American and European experiences for the United Nations; Brook and Irwin 2003 on the world experience for the U.K. Department for International Development and the World Bank; and Kessides 2004 for the World Bank Nellis and Birdsall 2005 on the world experience for the Center for Global Development; Alam et al. 2005 on Eastern Europe for the World Bank; and Estache and Wodon 2006 on Africa for the World Bank).²¹

The main message of this research is that the reforms of the 1990s have generally increased the efficiency of infrastructure sectors but that these efficiency gains have not always been shared with users, particularly the poor. The six main reasons why the poor have not always benefited can be summarized as follows: (i) when tariffs were redesigned to be more efficient, they sometimes became less progressive or more regressive (or both) than before the reform (such as when countries eliminated cross-subsidies); (ii) major increases in indirect tax rates—which tend to be more regressive—were applied to reformed infrastructure sectors to allow the state to capture part of the

One is poor land and sea transport infrastructure, which makes market development unusually difficult. Fan and others (2004a, b, c) provide impressive evidence on the various channels through which infrastructure contributes to poverty reduction and show how different these channels can be across as well as within countries.

²⁰ There are more than 400 cities with a population of over 1 million—up from 16 cities 100 years ago.

²¹ These institutions have also generated a huge number of unpublished studies and working papers, some of which are available on their Websites. There are too many to do them justice in this paper.

rent generated by efficiency gains; (iii) operators increased enforcement of revenue collections; (iv) Increases in quality made services unaffordable for some users; (v) cream-skimming in the design of restructuring eliminated cross-regional subsidies and thus slowed investment programs in the poorest regions when governments could not compensate through increased subsidies; and, (vi) failures to alleviate credit rationing added to the difficulties of financing poor users' expansion needs.

All this implies that poverty has not really been addressed carefully in the regulatory and other reform packages implemented during the 1990s. Recent studies on Eastern Europe (Alam et al (2006), Kanfuser and Tepic (2005), Estache and Wodon (2006) on Africa, Estache, Foster and Wodon on Latin America (2002) and Komives et al (2006) for a sample of countries covering various regions) show that affordability may be just as important a challenge as access is. In most cases, the negative poverty effects result from mistargeted subsidies.

Infrastructure policymakers tend to target access and affordability separately, relying on different instruments to achieve these goals. For access there are three basic categories of instruments: (i) those requiring operators to provide access (a service obligation to avoid unilateral exclusion by the provider),²² (ii) instruments reducing connection costs (through cross-subsidies or direct subsidies built into the tariff design or through credit or discriminatory payment plans in favor of the poor), and (iii) instruments increasing the range of suppliers (to give users choice, including the option of cutting costs by choosing lower-quality service providers).

For affordability, broadly speaking, while there are many instruments they all work in at least one of three ways: (i) by reducing bills for poor households (through lifelines or means-tested subsidies based on socioeconomic characteristics, or on the characteristics of the connection and financed through cross-subsidies or direct subsidies built into the tariff design), (ii) by reducing the cost of services (by avoiding granting a monopoly right when it is not necessary or by providing an incentive for operators to reduce costs and pass on the cost reductions to users), and (iii) by facilitating the payment of bills (by allowing discriminatory administrative arrangements in favor of the permanently or temporarily poor).²³

For a long time, analysis of these instruments focused on efficiency and was conducted at a fairly theoretical level by public finance specialists. But enormous methodological progress over the past 10–15 years has allowed the academic world to make much better assessments of the performance of these instruments not only in terms of efficiency but also in terms of their effects on the behavior of poor people and service providers. Methodological developments have occurred in three fields: microeconometrics (especially developments in the econometrics of panel data), evaluation techniques, and incentive theory applied to the theory of regulation. A recent book edited by Bourguignon and Pereira (2003) containing contributions from many of the key researchers in the field provides an exhaustive overview of the status of evaluation techniques. Although not yet widespread, a lot of this work also builds on the

²² This issue is not addressed in this paper; interested readers should see Chisari and others (2003), Clarke and others (2002), Cremer and others (2001), Gasmi and others (2002), and Laffont (2004)

²³ See Estache et al. (2004).

incentive theory presented in Laffont and Tirole (1993) in general and in Laffont (2005) for developing countries.

A look at the associated empirical evidence is somewhat disappointing for infrastructure policymakers. The leading academic economic journals contain relatively few specific articles on targeting, affordability, or regulation for infrastructure services in developing countries (especially relative to health and education services, where there is much more data and data quality lends itself better to academic publications).

While a lot more empirical evidence needs to be generated, the partial results available so far are surprising to many. Despite their popularity in policy circles, particularly for infrastructure, targeted subsidies (as well as safety nets) have long been held in low regard by academics for their alleged ineffectiveness (in terms of economic efficiency and incentive costs). But the verdict delivered by new databases is that in many cases these costs are modest. In other words, direct subsidies and cross-subsidies are not always as bad as they are made out to be. Moreover, these results seem to hold for both temporary and chronic poverty.²⁴

This finding simply confirms the intuition of many infrastructure practitioners.²⁵ The evidence suggests that the poor can be deprived of infrastructure services in many ways. They often need to benefit from a connection subsidy as so often mentioned by casual analysts focusing on the access problem but they also often need to benefit from a subsidy for what amounts to be a minimum level of consumption. Unaffordable consumption, even with access is useless and vice versa. For water and energy there are minimum consumption levels defined by international organizations and most countries (for example, 20 liters of water per person per day and 10 kilowatt-hours per household per day).²⁶

The evidence also suggests that because of the limited fiscal ability of many governments to generate enough revenue to finance targeted subsidies from general revenue, cross-subsidies are often the only realistic solution. They help finance the needs of the poorest through redistribution within a sector. For every documented mistargeted cross-subsidy, there is a documented success story of an effective cross-subsidy suggesting that they are an option to consider in practice. But it is also important to recognize that well-intended targeting mechanisms have also been regressive and that this regressiveness may come from a failure to target access, consumption or both.²⁷

But poverty is also very often a distributional issue as shown in section 2. To study the distributional dimensions of poverty and reforms, other techniques are increasingly popular in the research community. Evaluation techniques now allow for very systematic assessments of the distributional implications of reforms. A reform can help poor people and be regressive, but it can also be regressive without helping the poor. These issues can now be reliably handled quantitatively. New techniques allow

²⁴ For a useful recent review of the debate and survey of the empirical evidence, see Ravallion 2003.

²⁵ See Foster and others (2000a, 2000b, 2003, 2004) or Gomez-Lobo and Contreras (2003) for examples.

²⁶ In addition, in developing countries the rules of thumb are that households should not spend more than 5 percent of their income on water and sanitation and more than 5–10 percent on energy (depending on the region).

²⁷ Estache, Foster, and Wodon (2002) show how common this is in Latin America.

identification and monitoring of the most vulnerable groups with respect to reforms, as well as good evaluations of the relative and nominal impacts of reforms. But this literature provides much more than *ex post* assessments of policy reforms. It makes the case for systematic monitoring of the effects of new reforms and projects to ensure that they internalize lessons of the past. This can be done at the project level (see Baker 2003 and Duflo 2003 for surveys), at the sector level (Torero and von Braun (2006) for a large set of country specific cases studies in telecoms) or at the macroeconomic level. This can be important when micro-household data are weak or interactions with other sectors need to be assessed.

Finally, it is important to recognize as part of the design of infrastructure policies that infrastructure reforms do not happen in a vacuum but that they also have an impact on the poor through their impact on other markets (such as the labor market and investment savings market) that matter to the poor. These feedback effects are potentially significant for poverty alleviation, and an economy-wide analysis is needed. This usually calls for a multi-agent, multi-commodity model. Computable general equilibrium (CGE) models are increasingly becoming a useful analytical response to these needs.

CGE models simulate economic and social impacts of reforms and are based on the socioeconomic structure of a social accounting matrix (SAM), with its multisectoral disaggregation. The basic idea behind a SAM is to identify the linkages in an economic system. The basic elements when constructing a SAM are input-output tables combined with government accounts and household surveys. The household surveys are crucial for performing impact analysis on welfare and poverty. How deep the analysis can go depends on data availability. The CGE literature on the effects of public infrastructure service reform is rather modest: Adam and Bevans (2004) for Uganda, Boccanfusso et al. (2006) for Senegal, Chisari and his colleagues (1999, 2003) and Navajas (2000) for Argentina, Andersen and Faris (2002) for natural gas in Bolivia, and Logren and others (1997) for rural Morocco. Their main contribution is to show the importance of infrastructure for achieving the MDGs and, maybe most important, to show that good regulation is redistributive and progressive.

While a lot more research is needed to document these distributional dimensions, there is one old battle that these techniques have not yet helped address in infrastructure. This is the debate on the need to address urban and rural concerns differently. In general, there is a wide agreement that infrastructure in rural areas can improve agricultural productivity and reduce rural poverty.²⁸ But there is also some ongoing research on the impact on the rural-urban gap than can be credited or blamed on reforms. For Senegal for instance, Boccanfusso et al (2006) show that the water reforms have had a very different initial impact in the capital city, secondary cities and rural areas. Unless interregional cross-subsidies are considered, most common cost recovery financing policies would hurt the poor differently in each region when the fact that each region is dominated by a different set of providers type (i.e. large public, large private and small private) is accounted for.

²⁸ See for instance, Binswanger et al. (1993), van de Walle and Nead (1995), Lanjouw (1999) van de Walle (2002), Jacoby (2000), Gibson and Rozelle (2003), Renkow et al. (2004), Lokshin and Yemtsov (2005) or Warr (2005)

Adam and Bean (2005) find for Uganda that infrastructure investments that support tradables have different impacts on the distribution of poverty between rural and urban areas as well as on the real exchange rate and other macroeconomic variables. When infrastructure investment is biased towards sectors that favor tradables (i.e. telecoms or energy which tend to enjoy a much stronger demand from manufacturing and services than transport), the real exchange appreciation is the strongest. When it is biased towards non-tradables (e.g. rural and urban roads), there is hardly any change in the real exchange rate. The main difference between the two scenarios is a distributional one. The support of tradables helps all income classes, the support to non-tradables helps the urban poor and somewhat counter-intuitively hurts the rural poor, if population migration is ignored. The rural poor gains from more access to food and lose from the lower income they get from food production. This loss is stronger the more the infrastructure aid is biased towards non-tradable goods.

Adam and Bean (2005) is one of the rare quantitative illustrations of the current policy relevance of the old debate on the importance of rural vs. urban needs in infrastructure. There are however many less quantitative debates. One of the most talked about source of conflict is the extent to which there may be a dominating bias in favor of working on the alleviation of rural poverty rather than urban poverty.²⁹ Because there is actually little research on infrastructure on this topic, policymakers can only rely on anecdotal evidence. A commonly related concern not really addressed by researchers includes the possibility of a difference on this front across sectors (i.e. water vs. energy vs. telecoms vs. transport).

All this assumes, of course, that we know the evolution of poverty. There is plenty of evidence showing that poor people urbanize faster than the population as a whole, which implies that anticipating their needs will require a stronger focus on urban issues.³⁰ Yet in many regions, the sheer numbers argue otherwise. In Africa, for instance, more than two-thirds of the population remains rural today, and it will likely be awhile until the urban population becomes the majority. More generally, experiences across countries suggest that a majority of poor people will still live in rural areas long after most people in the developing world live in urban areas (Ravallion 2002).³¹

The choice of the priority between urban and rural is an empirical question (Reardon 2001; Sahn and others 2003), hence data matter. This is a problem. From an

²⁹ Many in the water community would argue against this, at least from the viewpoint of their sector. According to WHO statistics, for developing regions, rural areas have 5.3 times more unserved people for water supply and 3.6 times more unserved for sanitation compared with urban areas (WHO (2004)). This service gap is not really well correlated with the direction of the lending program of many donors. For instance, in the World Bank's lending portfolio between 1990 and 2001, urban areas received nearly six times more in loan funds than rural areas and since this is not explained by unit cost differences. It may be reflecting more strategic decisions on resource allocations. According to the World Bank Evaluation Department (OED), each dollar spent on a rural water system provides approximately four times the population coverage offered by an equivalent urban investment. This could imply that more should be done to cover rural areas, at least in some regions. Note that it could also imply that these numbers reflect a selection bias in the WB's portfolio. The improvement of our collective factual knowledge on this issue could also be an interesting research agenda.

³⁰ See Ravallion (2002) and Cohen (2004) for a discussion of population trends.

³¹ This is not a new debate. Almost 30 years ago, Lipton (1977) and Mellor (1976) were concerned with the opposite question: was the urban bias of the international community rational?

infrastructure viewpoint, Living Standard Measurement Surveys (LSMS), Demographic and Health Surveys (DHS), and household consumption surveys do not really provide the required data to address the issue well.³² First, the sector is generally not well covered in these surveys. Second, there are significant differences in the quality of the data available for urban and rural areas.³³ These data problems are important but can be circumvented. Loxsin and Yemtsov (2005) for instance come up with an interesting strategy to deal with data gaps to conduct impact assessments. They complement community level panel data from a regular household survey with a special module and use it to measure the impact of infrastructure rehabilitation projects in Georgia between 1998 and 2001. The analysis yields plausible rankings of welfare gains from different types of projects at low data costs for a specific country. The approach can be useful in dealing with the assessment of the impact of large scale community driven micro-projects or with government run decentralized investment programs.

Ignoring for a moment the data issues, there are some fundamental questions that have not been addressed by researchers. How consistent are the ideal strategies implicit in these differentiated needs assessments for the rural and urban poor with the strategies to maximize the odds of meeting the MDGs' poverty target? Where is the poverty reduction from an additional dollar of investment the highest? In highly dispersed rural populations or in highly concentrated urban or peri-urban populations? There are clear tradeoffs depending on the cost of technology (low unit costs in rural areas versus low average costs from economies of scale in urban areas). The odds suggest that, in the absence of a disaggregation between rural and urban needs across the MDGs, cost-effectiveness in achieving them may imply that rural poverty reduction will not get the priority it deserves.³⁴ On the other hand, the focus on the MDGs may hurt the urban poor in a different way. The distinction between the persistently and transiently poor is quite relevant in practice but not equally relevant to the urban versus rural poor. Yet the MDGs do not make this distinction and tend to focus on the persistently poor, which favors the rural poor. This implies that strategies designed to accelerate growth to achieve the desired reduction in an overall index of poverty may be better than those that benefit the persistently poor (Gaiha 2003).

5. Fiscal and other financing options as challenges

The main policy and academic debates on the fiscal dimensions of the sector are about the macroeconomic limits to public and private sector financing. The most important source of disagreement is probably the extent to which there is fiscal space to finance the major increase in infrastructure expenditures demanded by growth and by concerns for poverty alleviation. The debate is particularly sensitive in view of the fact that, while the scope for private participation is limited, it is important enough and

³² See also Sahn and Stifel (2004) for a discussion of data issues in Africa and Sahn et al. (2003) for a more relevant to assessing the relative importance of infrastructure in the poor people's expenditure patterns.

³³ Satterthwaite (2004) provides an interesting discussion of the data issues .

³⁴ According to Mitlin (2004), because of the typical failure to breakdown the urban averages (where access invariably looks much better than the rural because the rich live in cities), the benefit of the doubt in most country assistance planning, including PRSPs, is being given to the rural areas. She documents her point in a review of 23 PRSPs, finding that they definitely do not give much weight to urban.

increasingly associated with complex guarantee granted by the public sector with non-trivial potential fiscal consequences. It is also fueled by the fact that it is increasingly clear that in the poorest countries, there is a limit to full cost recovery that can be imposed on the poorest. This implies that direct or cross-subsidies are likely to be part of the financial equation that needs to be solved to ensure the satisfaction of providers, users, and taxpayers.

This suggests that the fiscal requirements and the financing options are closely intertwined. They could be two interconnecting sides of the same issue: how much budget expenditures can be allocated to achieve a certain level of growth would depend on the extent to which the users can cover the costs of the investments or operations and the level of affordability.

The core of the debate is about the importance of the design of macroeconomic fiscal adjustment programs for the level of investments in infrastructure. Standard fiscal rules adopted to ensure debt sustainability as part of macroeconomic adjustment programs are increasingly being criticized as excessively binding constraints on appropriate countercyclical action. Moreover, there is widespread concern that these rules may permanently reduce the public sector's contribution to capital accumulation, particularly in infrastructure. For instance, compression of public investment in infrastructure can be, and has been, associated under a wide range of circumstances with lower economic growth and less efficient poverty alleviation, which in turn has ended up fueling fiscal insolvency, the main concern expenditure cuts were supposed to address.

While this debate has been quite intense in Europe as part of the assessment of the Stability Pact (see Turrini, Buitier, and Graf for overviews), it is new in developing countries in the context of the search for an increased role of the private sector in the financing of the infrastructure sector. Raised in a book edited by Easterly and Serven in 2003, it has now been mainstreamed in the policy arena. The Brazilian and Pakistani heads of state have both mentioned during 2004 the need to find alternative solutions to fiscal adjustment that does not penalize infrastructure projects, while recognizing that the new rules would have to avoid white elephants.

The debate can be summarized as follows: standard IMF adjustment programs want to ensure that public expenditures, including sectoral allocations of expenditures, are consistent with the short-term liquidity constraint faced by a country, the short-term aggregate balance (no inflationary pressure due to excess demand), medium-term debt sustainability, the need to avoid endorsing excessively costly or inefficient levels of public expenditures, and the promotion of private participation in infrastructure.

If general principles seem to be agreeable to all parties, there is some disagreement on how to address each of these concerns because there is no agreement on the specific measures to consider. For each of these concerns there is some scope for sensitivity analysis. There is concern that the liquidity constraint gives a lower bound for *all* the expenditure levels to consider rather than a precise indicator. While this is a useful indicator, it needs to be complemented by an assessment of an upper bound. This upper bound comes from three sources: (i) the definition of liquidity (see Easterly and Serven 2003 for illustrations of this for Latin America), (ii) the time horizon during which this liquidity (whatever the specific concept) needs to be considered and averaged out, and (iii) the level and type of expenditures to be included—that is, which kind of public

enterprises (with or without a hard budget constraint)? Should public enterprises be outside the budget, as in Chile? Which kind of projects? Which kind of guarantees should be accounted for as expenditures and at what time? Should it be done on a cash or on an accrual basis? And should recurrent and capital expenditures be systematically separated for every sector (à la Blanchard and Giavazzi 2003).

In addition, it seems reasonable to have a better sense of the relevance of the level, origin, and timing of the financing sources for the assessment of the desirability of infrastructure investment in view of the fact that this has been one of the most creative areas in infrastructure policy over the last 10-15 years. The basic questions that need to be answered include: Which kind of financing sources, fiscal or quasi fiscal expenditures, need to be covered? Do the sources matter (international financial institutions and bilateral donors are fine, but others are more risky)? When are guarantees a quasi fiscal deficit? What share of private participation throws the project off balance, and will this choice lead to cream skimming in the design of projects? Should it be driven by risk sharing levels or by something else?

There are many more related technical issues but they go beyond the scope of this paper. One, however, deserves to be highlighted. What needs to be recognized in estimates of the fiscal space is that solvency is by definition an intertemporal concept. Indeed, solvency has to rely on the present value of both assets and liabilities. Many academics have pointed out that it does not seem correct to assess the strength of fiscal accounts only from the time path of gross financial liabilities. (For an economic discussion see Ballasone and Franco 2000; Blanchard and Giavazzi 2003; Buiter and Grafe 2004; or Turrini 2004. For an accounting viewpoint, see McCrae and Aiken 2000.)

Of particular interest in this context is the fact that infrastructure has an unusual cash flow, with high short-term costs and high long-term returns. Standard fiscal accounting ignores this and introduces a bias against any project with a cash-flow stream that is initially negative, with costs incurred in the present but returns accruing only over time. This bias leads to excessive compression of investment as well as operation and maintenance expenditures, particularly during the transition toward a deficit target, and can be most damaging for expenditures that help enhance future growth. Indeed, any analysis of infrastructure needs to distinguish between recurrent and capital expenditures and rate them according to their contribution to the growth and social agenda. These two are linked, but their relative importance varies significantly across sectors. Yet cuts tend to be across the board—with brutal (including regressive) distributional consequences (see Calderon and Chong 2004).

Recent research is actually further widening the debate and the viewpoints. Engel, Galetovic and Fisher (2006) suggest that it is useful to look at the fiscal cost of PPI from the viewpoint of the relevance of the financing modes to the public sector accounts. They establish an “irrelevance result” arguing that under a reasonable set of circumstances, the deficit should not be influenced by the financing mode of infrastructure. There are many situations in which this irrelevance results does not hold but the point of the authors is that it should be possible to forecast the sign of the impact based on the specific situations to be addressed. Tirole (2006) is widening the debate into politics and of the need to link the assessments of incentive problems in the sector to their fiscal consequences.

But this is not only an accounting problem. Over the past 20 years, political decision-making has replaced economic criteria in determining the allocation of resources in developing countries. Indeed, 20 years ago all the multilateral development institutions had their own manual of economic cost-benefit analysis that was supposed to be used as part of annual public expenditure reviews. These reviews were supposed to guide the allocation of resources across sectors. Sectoral allocations and intra-sectoral investment decisions were easy to implement since they were driven by economic rates of return. The changes in the resource allocation process over the past 20 years have resulted in less investment in infrastructure (to a large extent because of its lower profile in the ODA agenda), without much regard to the economic returns.

At least as importantly for some sectors and for some countries, there is a need to monitor the allocation of resources to the maintenance of the assets. For instance, Riojas (2003b) shows that in some countries, maintenance may actually be more important to growth than investment. Along the same lines, Kalaitzidakis and Kalyvitis (2004) show with an infrastructure-led growth model where the durability of public capital is endogenous and varies according to its usage and the level of maintenance expenditure that changes in total expenditures and the maintenance share drive the steady state and the dynamic behavior of the economy.

Whatever the outcome of ongoing research on the sustainable degree of public expenditures in infrastructure and on its allocation between maintenance and investment, for many countries, partnerships with the private sector will continue to be a rational option. Probably, the most challenging dimension of these partnerships will be the diagnostic of the impact of risk allocation between the public and the private sector on the decision of the private sector to enter a deal.

Despite the relevance of the design of risk allocation mechanisms, there is relatively little innovative theoretical infrastructure-specific literature on this topic from researchers specializing in the modeling of agency problems. This is surprising since the theoretical literature on the scope for public-private partnerships is quite large and has filled many pages of some of the most technical journals in economics. Laffont and Tirole (1993) catalyzed this literature, but see also Armstrong and Sappington (forthcoming), Bos (1994, 2003), Hart (2003), Newberry (2000), and Laffont (2000, 2005). This research has however generated a few useful insights.

The first main lesson of this literature is that regulators must arbitrate between risk levels and their distribution, the efficiency levels that can be achieved in infrastructure, and the rents that remain with operators. In other words, to be viable, a financing mechanism and a regulatory regime may need to rely on a risk allocation that does not yield the most efficient outcome in service delivery. This means, for instance, that when risk levels are perceived to be very high, rate of return regulation may be more effective at attracting private capital than a price cap regime. More generally, this literature argues that the characteristics of developing countries should often lead to recommendations quite different from those that would be given for infrastructure restructuring in industrial countries. Indeed, the limited enforcement capabilities in developing countries are significant in practice and, along with unusually high risk levels, are one of the main reasons one size does not fit all when reforming infrastructure. This

literature also hints at the relevance of many other institutional issues, including the relevance of the degree of capital market development, as discussed next.

A second strand of research has tended to focus on issues associated with the degree of development of local financial markets. It is quite wide and to some extent beyond the scope of this paper. It typically deals with more than just the financing needs of infrastructure (see Bortolotti and Siniscalco 2004 for a recent survey on the world experience and von Hirshausen 2002 for an insightful discussion of the interactions between institutional development and infrastructure reform in Eastern Europe). The main message is simple: institutions matter, and this message is now the bread and butter of many aid agencies.

A third area of research focuses on the optimal distribution of risks between the players in the financing game and involves the development of innovative risk mitigation products and applications to foster private capital mobilization for infrastructure development (see Esty 2004 for a wide review and Irwin 2003 for a more direct application to infrastructure). The literature offers four main lessons to policymakers. From a strictly financial viewpoint, the financial structure matters—and in ways that are quite relevant to the design of financing strategies in developing countries. Of particular interest is the importance of the governance structure associated with the financing of infrastructure projects, as documented in a survey by Becht and others (2003). Second, in more general terms, this literature shows how improved risk allocation mechanisms addressing currency risks and regulatory risks can help reduce uncertainties faced by private investors assuming infrastructure-related risks (Marrison (2001)). Third, credit providers can gain from coordination to reduce everyone's risks levels when capital markets are imperfect (Tirole (2006b)). Finally, related to this literature with important implications for infrastructure is a growing body of research demonstrating the importance of auditing and the limits of creativity in financial designs when financial accountability is limited (see Legros and Iossa (2004)).

The fourth area of research reflects the fact that a large part of infrastructure development takes place at the sub-sovereign level, with sub-sovereign entities responsible for the provision of public services (see Freire and Peterson (2004) for an overview). Fiscal capacity is a major issue when it comes to financing sub-national investment needs (see Lewis 2003 on Indonesia, for instance), and hence supporting the transition of these entities from sole central government funding to market-based funding where they can also access private financial markets for their needs is critical to mobilizing additional private capital for infrastructure services.

While these four branches of research all provide interesting insights, the punch line is a modest one. The main lesson of this literature may be that new instruments will have to do better in terms of generating the appropriate credit enhancement to achieve creditworthiness at the project level and often at the local government level. We actually still don't know much about how to implement this advice in real deals with high risk levels. The next generation of infrastructure contracts between the public and the private sector will have to do a better job at allocating these risks.

Of particular interest is to develop a "law and economics" research agenda which would investigate the relevance of risks associated with the mismatch between legal systems and the choices of regulatory instruments associated with infrastructure reforms

commonly considered by governments—i.e. concession or affermage contracts and creation of independent regulatory agencies. Francophone Africa and many countries in other parts of the world have often reacted negatively to the imposition of independent regulators which did not really fit into their legal tradition. Concession contracts have passed on to these regulators rights which typically should go through other channels under existing constitutional arrangements dividing responsibilities between the three branches of government. As a result, regulators are sometimes viewed as a fourth branch of government. While there is a lot of work done on the relative “effectiveness” of the various legal systems in their pure forms in terms of their efficiency, equity or fiscal effects, there is very little work looking at the cost of hybrid solutions in which sectoral legal systems, contract forms and regulatory processes or instruments are combined from various legal traditions. Until we have solved this issue, regulatory and legal risks will continue to be major obstacles to successful public-private partnerships in this sector.

6. Corruption: do we know what’s going on?

The final broad research theme emerging from the recent reform experiences in infrastructure may be the most complex one. At face value, it is about corruption. Ultimately, it is about accountability for governance failures but it deals with a type of failure requiring much more political commitment than skills, particularly in a sector where corruption has been known to exist for quite a while.³⁵ In addition to the usual explanation of low wages in the public sector, two important features of infrastructure drive the higher than average risks of corruption: projects tend to be bigger than in other sectors, and services are often granted with a monopoly on delivery as well as over control of the information needed to ensure that there is no abuse by the monopoly.³⁶

While these characteristics have not changed much over time for electricity and water distribution and for much of transport infrastructure, the perception of their impact on corruption has evolved. In the early 1990s, the existence of widespread corruption among public monopolies in the sector was often one of the arguments used to motivate privatization. This was supported by the theoretical modeling of corruption as the non-benevolence of government by authors such as Shapiro and Willig (1990), Shleifer and Vishny (1994), and Boycko, Shleifer, and Vishny (1996) and a lot of anecdotal evidence.³⁷ Assuming that it is easier for corrupt politicians to control public firms than private firms, these researchers argued that privatization could reduce the control government has over the rent offered by the full control of the sector by making political interference more costly or more visible.

³⁵ Flyvberg et al (2003) is an extraordinarily useful source to get a sense of the size of the problem in this sector, in particular in developed economies.

³⁶ Favoritism, fraud, cronyism, patronage, embezzlement, bribes, and state capture are all concepts that have long been associated with the delivery of infrastructure services in many countries. There is an extensive literature on how to define corruption and on the semantic practices of different institutions; a helpful recent survey is Lanyi (2004). For a recent survey on economic analysis of corruption, see Aidt (2003); on levels of corruption, see Kaufmann and others (2003).

³⁷ There are now models coming up which generate incentive structures consistent with the Latin American stylized facts and which show that there are cases where private ownership can foster investment while increasing corruption. See Martimort and Straub (2006).

Many reforms later, the main debate has now shifted from the interactions between public operators and users to those between private operators and government. This can be seen in the survey prepared for Transparency International on corruption and privatization in infrastructure in developing countries (Boehm and Polanco (2003) and TI 2005). It is also clear in various publications by NGOs (Finger and Allouche (2002) and Hall and Lobina (2002)), documenting legal events that have demonstrated incidents of corruption in the sector. Friends of the Earth (2001) and various political scientists have documented the role of corruption as a cost driver in contract negotiations and renegotiations in the sector. There is also an increasing body of academic evidence. Flyvbjerg and others (2002, 2003a, 2003b, 2006) and Mitlin (2002) for instance all document how undesirable practice fuels cost excesses at the project level. More conceptual research is also analyzing the changes in the global market structure characterized by an increased domination of this market by a few players.³⁸ Celentani, Ganunza, and Peydros (2004) develop a model consistent with the fact that an increase in competition in international business transactions can increase corruption in the sector.

Most of the evidence offered by these surveys is however anecdotal and indirect. There is no real systematic measurement of the level of corruption in the sector. With the exception of a database compiled by Clarke and Xu (2003) for Eastern Europe and some sense of the ranking of utilities among corrupt institutions from the *Global Corruption Report* (2004), the annual *Global Competitiveness Report* provides the only comparable, quantitative, multi-country (59 developing countries) overview of corruption in infrastructure sectors, ranking countries according to the perceived degree of corruption (based on interviews with private firms) among many other criteria.³⁹

Even if no encompassing or overwhelming quantitative evidence is available on the extent of corruption in infrastructure, there is a small body of research on its effects on infrastructure performance. Most is for utilities. A few authors report direct measures of corruption in the sector (Davis (2003) on South Asia; Lovei (1998), Lovei and McKenchie (2000), and Clarke and Wu (2004) on Eastern Europe, Reinikka and Svensson (2002) and Svensson (2003) on public services in Uganda). A few others provide indirect impact assessments from regression analysis testing the statistical significance of country wide corruption measures on infrastructure performance indicators (Rossi and del Bo (2004) on Latin American electricity companies; Estache and Kouassi (2002) on African water companies, Estache, Goicoechea and Trujillo (2006) for all utilities across developing countries). A very promising research area is the use of randomized field experiments. A recent paper by Olken (2005) reports the results of such an experiment in Indonesia which measures missing expenditures in over 600 village projects. To do so, the author relied on a comparison of the villages' official expenditure reports with estimates of the prices and quality of all inputs used in road construction and maintenance, each made by independent engineers. This approach allows a separation of the sample into sub-samples designed to test the effectiveness of various types of policies in reducing corruption.

³⁸ Benitez and Estache (2005).

³⁹ There are also country-specific databases dealing with public services, but these are the exception rather than the rule (see Reinikka and Svensson 2002, Svensson 2003, and many of the country reports from Transparency International available on its Website).

What do these studies show? Most of the evidence confirms the expectations. First, the basic data analysis from the Global Competitiveness report suggests that the frequency with which firms have had to make undocumented extra payments or bribes to get connected to public utilities or to gain public contracts is, on average, negatively correlated with the income of the countries. These responses suggest that the poorer a country is, the bigger the corruption problem in infrastructure. While useful these data are also far from being precise. They are based on executive surveys which are known to have their share of problems. More importantly, it tells us little about what the government or the residential infrastructure users think about corruption. Second, corruption can be tracked to greater constraints on utility capacity and lower competition among utilities. This is found by Clarke and Xu (2004) for 21 Eastern European countries. They also find that public ownership in that region is more correlated with corruption than private ownership of utilities. Third, corruption can be associated with higher than expected costs. The most detailed studies (Flyvbjerg and various colleagues) show that excess costs can be attributed to procurement rules that give bidders an incentive to announce low costs to increase their chances of winning projects, then renegotiate.

Procurement rules by themselves are not enough. Auditing contractual compliance also matters. Olken's detailed analysis of Indonesian roads projects is a good illustration. He tests formally the potential payoff of audits and other policy instruments intended to reduce the costs of corruption. His assessment implies that announcing an increased probability of a government audit from a baseline of 4 percent to 100 percent, reduces unexplained costs by about 8 percentage points. This cost saving justifies the costs of audits.

But not all results are as expected. Most of the surprises come from indirect estimates of the effects of corruption on infrastructure services based on cross-country regression models measuring corruption at the country level rather than at the sector or project level. Mauro (1997) and Tanzi and Davoodi (1997) find opposite signs on the effect of corruption on public spending: Mauro finds that it increases these expenditures, Tanzi and Davoodi argue that it lowers them. Considering the characteristics of the sector, this apparent paradox may actually not be one. Corruption may raise unit costs and hence increase spending in one sample. But under budget constraints dominating another sample, it may reduce the number of project and because projects are lumpy, it may ultimately decrease spending in the sector.

More recently, Estache, Goicoechea and Trujillo (2006) offer an econometric test of the impact of the 1990s infrastructure reforms and of corruption as well as of their interactions on access, affordability and quality of infrastructure services in developing countries. They find that corruption hurts access rates and quality in electricity and telecoms affordability for residential users, has no statistically significant effect on water access rates and on water and electricity affordability but favors access rates and quality in telecoms. Once more there are reassuring explanations to these results. In many countries, the telecoms sector was the first to privatize. This did not happen easily and many of the participants to these initial transaction report that the opening of the market did require some type of side payment. This does not make the side payment right. The outcome, however, is an increase in access and quality. These improved access rates did

come at a cost: higher tariffs for the users in a sector in which technology keeps pushing costs lower. For electricity, corruption did not have an impact on prices but it did hurt quality and access rates. In sum, when corruption is about money—rather than about power or similar non-monetary ambitions—, it will eventually generate higher cash flows for the corrupt parties. It can do so by increasing revenue from infrastructure services, i.e. increasing access and hence users or prices. Alternatively, it can do so by cutting costs, i.e. reducing quality. Both of these strategies are easier to implement for a monopoly when it is poorly regulated or when the regulators and the operators collude as amply discussed in Laffont (2005) and later in this paper.

Another puzzling finding comes from Rock and Bonnett (2004). They show that while in most regions corruption has the expected negative effects, in large East Asian countries with governments with long time horizons, corruption has had positive short- to medium-term effects on growth thanks to collusion between governments and their big business partners. But Rock and Bennett also point out that it is not clear that the investment choices associated with corruption in these countries are the right ones for long-term growth since they cater to the preferences of local businesses. Thus corruption has long term costs in this case as well but these are much more difficult to assess.

What can we do to reduce corruption in infrastructure? There are basically four main directions in which theoretical researchers have been pushing for over 20 years: (i) privatization, (ii) regulation and related processes, (iii) increased decentralization, and, (iv) adoption of participatory process in the selection, implementation, and supervision of projects. Since many countries have tried these recommendations, we now have enough new facts to analyze. This analysis is still very young but already yielding interesting results.

The evidence on the impact of infrastructure privatization on corruption is actually not that wide yet.⁴⁰ Laffont and Meleu (1999) may provide the most general description of the interactions between the two. Looking at Africa's experiences, they point to a U-shaped interaction between corruption and the privatization rate in Africa. That is, up to a point, corruption facilitates privatization—but eventually it hurts it. This finding needs to be contrasted with the fact that, in a recent survey, corruption was considered the biggest obstacle to doing business in the region (reported in Nwanko and Richards 2001). These two stories imply that for now, corruption in Africa is an impediment to the adoption of a policy that could reduce corruption!

Some of the literature on the impact of the nature of ownership on the efficiency of operators can be interpreted as a proxy of the impact of privatization on corruption when efficiency is measured by costs. Among the few relevant papers offering this possibility is Kirkpatrick and Parker (2004). They report on several of the papers they have worked on. The first of interest here is their analysis of a large sample of African water utilities in the year 2000. They find that ownership did not statistically significantly

⁴⁰ It may be useful to point out that the widely available evidence on the governance payoffs of privatization in general do not necessarily apply to infrastructure privatization. Privatization of competitive industries, most of them unrelated to any concept of public service, entail very different actors and very different interests. These differences have seldom been accounted for in the literature on privatization which tends to extrapolate whatever is learned from telecoms, the most competitive of the infrastructure services to all other infrastructure sectors.

matter to their costs. While the authors do not formally test the linkages between corruption and ownership, it could be argued that if costs were influenced by corruption, ownership then has no impact on corruption. A second relevant paper refers to a large sample of electricity companies for which they show that privatization needs to be coupled with regulation to have the desired impact on prices. In our context, their result could be interpreted as meaning that a switch to private ownership could cut corruption when well regulated.

Looking at a much larger data sample and covering a longer time period (1990-2002), Estache, Goicoechea and Trujillo (2006) provide a formal test of the interaction between privatization and corruption by assessing their impact on access, affordability and quality of infrastructure services in developing countries. Relying on a set of interaction dummies in a model explaining these variables, their conclusion is that privatization generally does not statistically significantly interact with corruption in electricity, telecoms, or water. This is in contrast with the conclusion drawn by Clarke and Xu (2002) who find that in Eastern Europe, switching from public to private ownership did reduce the level of corruption. Overall, the fact that this survey only reports three studies suggests that there is little empirical work providing formal testing of the effectiveness of privatization as a way of reducing corruption. This is a clear research agenda to consider complementing the relatively large literature on the impact of infrastructure privatization on efficiency, quality or equity. It also needs to get at the core of what seems to characterize monopolies as suggested by Estache et al (2006). The objective is to maximize profits. However, researchers have tended to focus on prices, quantities and quality independently simply because data on profit is not available. They now need to start looking at how reforms jointly impact these variables, and hence profits, to offset the consequences of corruption—e.g. there is no need to impact prices if quality and hence costs can be cut to increase profits.

The second instrument generally recommended by researchers is regulation. Regulation must promote (static and dynamic) efficiency while it protects consumers, in particular the poor, from potential monopolist abuses, and investors and operators from political influence. Some degree of flexibility is desirable, but the track record of governments in their use of flexibility is generally perceived as having been so problematic that the rules built into various privatization instruments are designed to limit this flexibility. One of the key components of these safeguard mechanisms is the specific design of regulatory institutions. This points to the importance of independent, autonomous, and accountable regulatory institutions for sustainable reforms in regulated sectors. A major contribution of the theoretical literature summarized in Laffont (2005) in the context of developing countries is to show that processes, particularly quantitative processes, matter much more than policymakers seem to appreciate. In practice, this means reforming planning processes to get incentives right and to make information more transparent and better audited. The adoption of regulatory accounting guidelines for instance is commonly omitted by reformers and yet central to the ability to come up with fair, efficiency and accountable regulatory decisions.⁴¹ This is in fact quite consistent with the theoretical case for monitoring, auditing, and associated penalty systems (see

⁴¹ See Estache et al. (2003) or Schlirf et al (2006)

Faure-Grimaud, Laffont, and Martimort 1999, Armstrong and Rochet 1999, or Khalil and Lawarree 2001).

Once more, time should be on the side of researchers and new databases are emerging which cover a long enough time span to generate useful information. The most promising line of research may be the one followed by Olken (2005) to test the effectiveness of regulatory processes such as audits. But this type of research takes time and resources. A complement in the short run is to rely on cross-country econometrics to squeeze as much information as possible from international databases. Recognizing the difficulty of modeling something as complex as regulation, Estache, Goicoechea and Trujillo (2006) rely on the largest current data set to test the interaction between corruption and regulation in terms of its impact on access and prices of utilities services in developing countries. Regulation in their model is approximated by the existence of an independent regulatory agency, i.e. an institutional variable to address an institutional problem. They find that often these agencies have been an effective instrument but they do not perform equally well across sectors and across regulatory objectives. These agencies manage to offset the impact of corruption on electricity and telecoms access but they have no effect on the impact of corruption on water access. In terms of prices, the story is less clear. Regulation reduces the impact of corruption on residential phone services and reinforces this impact on industrial electricity prices while it has no effect on the other prices. These mixed results are generally consistent with partial results obtained by other authors. Kirkpatrick and Parker (2004), in their analysis of the African water utilities in the year 2000, also find that regulation does not have a statistically significant impact on their costs. Following a similar rationale to the one adopted in the case of privatization, if costs are influenced by corruption, regulation then has no impact on corruption. For electricity and in a wider country sample, these authors find that regulation can matter in improving performance but not for all types of indicators, consistent with the Estache et al (2006) results. As in the case of privatization, the extent to which regulation actually does offset the undesirable effects of corruption on infrastructure services is also a promising research topic. Finally, Guasch and Straub (2005), also model the interaction between corruption and regulation but in the context of its effects on the renegotiation of infrastructure concessions in Latin America, as opposed to its effects on infrastructure outputs. They find that the stronger the level of corruption, the more important the effect of having a regulator in place to limit the incidence of renegotiations. There is also a very large body of theoretical literature on what regulation and how regulation can help (see Laffont (2005) on what it means for developing countries). We are however far from having matching evidence on the topic.

Decentralization is the third way suggested by theory to increase accountability and hence cut corruption.⁴² Since the 1970s many countries—particularly developing countries—have seen a major increase in decentralization. There is a tremendous amount of economic research on the topic in general, but again an amazingly modest amount in terms of its implications for infrastructure. Bardhan and Mookherjee (2000a, 2000b, 2003) have offered some of the most influential recent papers on the topic. Moreover, they focus on infrastructure, highlighting the role of local corruption in the effectiveness

⁴² A notable exception is Shleifer and Vishny (1993) who argue that more vertical tiers of government tend to deteriorate governance.

of public service decentralization. They show that conceptually, under fairly mild assumptions, decentralization financed by user fees rather than local taxes or intergovernmental grants is superior, no matter how poorly local democracy works. More important, if user fees are not used, the superiority of decentralized over centralized service provision is no longer as clear-cut as many policy advisers seem to believe when corruption is explicitly taken into account. Finally, the authors show that when ability to pay is constrained and user charges cannot be used to finance antipoverty programs, the optimal degree of decentralization depends on the degree of corruption in local and central governments. This is research that begs to be tested.

For now, there are relatively predictable tests of the impact of decentralization on the efficiency of the various delivery modes and types for infrastructure, especially in developing countries (see Shah and others (2004) for a recent general survey). There is however very little looking at the interaction with corruption. Bardhan, P and D. Mookherjee (2006) offered a recent survey focusing of the theoretical results.⁴³ The first relevant empirical results are those obtained by Estache and Sinha (1995). They show that for a sample of 10 industrial and 10 developing countries covering the 1970-1992 period, decentralization tends to increase total and subnational spending on infrastructure much more in developing than in industrial countries. This could imply two things: either preferences change with decentralization or cost increase with decentralization. The models tested do not allow differentiating between the two explanations. Similar but more specific results are reached by Fisman and Gatti (2002a) with a much more sophisticated model specification applied to a data set of 59 countries. They find a negative sign between corruption and decentralization for the 1980-95 periods. Recent results published by Faguet (2003) would suggest that decentralization is more of a demand revelation mechanism than a stimulus to corruption increases. He shows that in Bolivia decentralization has led to a re-ranking of investment programs in favor of agriculture, education, and water and sanitation. These are useful preliminary results but they beg for confirmation. More country specific studies such as Faguet's or cross-country studies doing a fuller diagnostic are indeed needed before being able to claim that decentralization is a much more successful instrument to deal with corruption.

The last interesting area of research is one looking at the interaction between infrastructure decentralization and privatization. Ghosh et al (2006) working with a data panel for 40 countries between 1990 and 2000, find that fiscal decentralization significantly affects the level and frequency of private participation but administrative and political decentralization do not. Fiscal decentralization tends to increase private sector participation in infrastructure. If decentralization is a demand revelation mechanism, this result is somewhat surprising in view of the increasingly loud voices against private operation of public services in Latin America.

In many ways, the development of the recommendation of more participatory approaches to service delivery--the fourth type of policy solution to mitigate the risks of corruption--can be seen as a by-product of the literature on decentralization (see Turk (2001), for instance, on how this is playing out in Vietnam). As with decentralization,

⁴³ There is a large public administration literature documenting the impacts of various forms of public service decentralization in developing countries. There is also quite a bit of analysis of decentralized health and education services, recently reviewed in the World Bank's *World Development Report 2003*.

little of the published economic research focuses on infrastructure services (recent exceptions include Chuwa and others 2002, Keemeier 2002, and Ackerman 2004). Yet efforts to promote participation in projects, programs, and policy consultations are now common in the international community. While there is nothing specific to infrastructure, many of the assessments of these approaches are based on qualitative or impressionistic rather than quantitative assessments.⁴⁴ As pointed out by Ghazala (2004), until his own 2004 paper, not a single study had established a quantitative causal relationship between any outcome and participatory elements of a community-based development project.

The main picture emerging on our knowledge of effectiveness of participation is one of concern. Ghazala (2004) and Cornwall (2003) both observe that projects claiming “full participation” and “empowerment” have turned out to be driven by particular interests or elites, leaving the least powerful without voice or much choice. In sum, the poverty reduction effectiveness of these programs needs to be measured more systematically as well. The one quantitative study for an infrastructure activity is published by Olken (2005). He test the effectiveness of the use of grass-root monitoring of rural roads expenditures and reports that increasing grass-roots participation has little impact in reducing corruption associated with road expenditure in Indonesia. Furthermore, he shows that top-down monitoring may be a better solution, even in a highly corrupt environment. In other words, traditional regulatory instruments have been more effective in the case of Indonesia’s road program.

Overall, this overview of a large volume of theoretical research on how to deal with corruption suggests two main areas in which further efforts are needed. The first one is data. The measurement of corruption levels in the sector is still generally approximated by the level of corruption in the country. The second area in which further work is needed is that the assessment of the effectiveness of these policy instruments for the infrastructure sector. The main message of this discussion of the effectiveness of theoretical solutions may be that there is not enough evidence to get a sense of how much and under what circumstances each one of them really matters. When evidence is available, it is too narrow or not robust enough. This defines an important research agenda for the sector. Finding out more about the actual effectiveness of the theoretical recommendations on how to deal with corruption in the sector should be a higher priority.

7. Concluding comments

The paper has reviewed a large volume and a wide range of research and experiences but it is incomplete. There is plenty of good research on the topics I have not been able to report. More troublesome may be the topics I left out, not because they may not be important but simply because they have not been on any researcher’s radar screen for some time and are hence not addressed in the recent literature surveyed here.

Chief among these omitted topics is the need to revisit what we can say on how to improve the performance of public providers of infrastructure services when privatization is not an option. A lot of energy has been spent over the last 10 years in focusing on what works and what doesn’t with public-private partnerships but very little has been allocated

⁴⁴ Isham and others (1995) is a notable exception.

to thinking about how to manage public enterprises better.⁴⁵ In retrospect, this is unfortunate. The private sector did not finance more than 20-25% of the total investments in recent time and the trend is a declining one for now. The good deals in energy and telecoms have been signed and massive new inflows are unlikely for a while. In the foreseeable future the public sector will continue to be a key actor, in particular in the lowest in some countries.

Closely related is the need to look into the regulation of public operators. Most of the research on infrastructure has tended to focus on the independent regulation of private operator. What about the independent regulation of public operators? Are the regulatory instruments going to be the same for public and private monopolies? Would regulatory accounting standards be the same for these two types of monopolies? Does it make a difference to the choice and design of regulation if governments look into options of public-private partnerships which do not require private sector investment?

Also related is the need to establish a much better bridge between the good theoretical research being conducted on procurement and the design and implementation of policies to procure public services in infrastructure. While auction theory has had a huge impact in the telecoms (e.g. spectrum auction), in electricity (in the design of power pools) or in airports (slot allocations), its major contributions have hardly trickled down to more standard public sector procurement—neither at the country level, nor in the procurement practice of bilateral or multilateral donors for that matter. The potential costs savings and cost controls that can be achieved from auctions is indeed seldom considered in public sector reform. Similarly, the screening of participants, structure of contracts and the degree of centralization of procurement decisions in the private sector have much better internalized theoretical progress, capturing significant benefits, than in the public sector.⁴⁶ Much of the recent research has also developed much more advanced test to minimize the risks of collusion while continuing to benefit from the interest of a wide range of bidders.

Finally, a common point to all the themes touched upon in this paper is the need to generate data. This is not just to get more and better research which will eventually guide future reforms and policy choices in the longer run. It is above all essential to increase the short-to-medium run accountability of all actors involved. Trying to improve the accountability of donors, governments, politicians, operators, investors and users through institutional reforms will not go very far until there is enough quantitative information to spell out a baseline from which progress will be measured. The MDGs are a good start, but as shown in this paper, accountability should not only be about access, it should also be about affordability, about public and private costs, about risks and about quality. Without more and better data on these dimensions of infrastructure service delivery, there will be no accountability in the sector. So far, when accountability has failed, the poorest users and the taxpayers have tended to bear the bulk of the costs of poor service and of corruption.

⁴⁵ A rare exception is Gomez-Ibanez (2006)

⁴⁶ A forthcoming book edited by Dimitri, Piga and Spagnolo (2006) may be the first since Laffont-Tirole (1993) addressing the procurement issues thoroughly. Moreover, this book also has the benefits of many more illustrations of relevance to practitioners.

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