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Public Private Partnerships in Water and Electricity in Africa

Emmanuelle Auriol,
ARQADE and IDEI Toulouse Sciences Economiques (eauriol@cict.fr)

Aymeric Blanc,
AFD, Département de la Recherche (blanca@afd.fr)

Département de la Recherche

Agence Française de Développement
Direction de la Stratégie
Département de la Recherche

5, rue Roland Barthes
75012 Paris < France
www.afd.fr • Site-AFD@afd.fr

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Abstract

The paper analyzes the costs and benefits of private participation in the electricity and water industries in Sub-Saharan Africa. Contrary to conventional wisdom, the participation of private unregulated firms in the supply of services for the middle class and poor is fairly common in the region. This private involvement reflects the extreme weakness of African governments. By contrast, service to the rich is provided by public utilities. Theory then suggests that prices should be high, so that the public firms make a profit. Yet piped water, and to a lesser extent electricity, are heavily subsidized. This signals a problem of capture by the ruling elite. It is a matter of justice and efficiency to increase public utilities revenues to subsidize investment and fiscal relief. This is especially relevant in electricity, where the economies of scale are much larger than in water. Electrification is the biggest challenge to the African economy because it requires huge investment. Local and regional private investors can play a non-negligible role in reducing penury. However, their involvement is conditional on the financial health of the sector and on strong government commitment.

1. Introduction

From 1990 to 1997, there was a substantial and unanticipated increase in private capital flows to the developing world. The movement created the hope that the private sector would be the next provider of investment in infrastructure and public utilities in poor countries. Ten years later, the assessment of the financial flows involved in the process is sobering. Since the Asian financial crisis of 1997, private investors, major commercial banks and international organizations have retreated from the sector. This withdrawal has been amplified by the weakening of the global infrastructure industry. As a result, infrastructure finance to developing economies from international sources has declined by at least 50%. Yet at their peak in 1997, they were just 3.6% of total new international bond, loan, and equity issuance (World Bank 2004). It is clear today that international private capital flows are not going to fill the huge investment gap in poor countries' infrastructure needs. This is especially true in Africa, which is the focus of the paper.[1]

Sub-Saharan Africa is the only region in the world not on track to meet any of the Millennium Development Goals (MDGs), but the situation is not as bleak as it might seem at first sight. First of all, the average growth rate for the region has been a steady 4% over the last 5 years. Although some of this expansion is explained by high growth in oil- and metal-exporting countries, more than half of Sub-Saharan African countries have grown by 4% or more on average during the period. Moreover, this represents a continuation of a trend over the past 15 years. GDP is projected to grow at an average of 5% over the next three years (World Bank 2006). However, realizing this growth potential is conditional on making substantial progress in the provision of essential public goods and infrastructure, notably electricity. Second, some of the rare "success stories" with PPPs in electricity or water took place in Africa, the private partners being international operators, as in Côte d'Ivoire and Senegal, or local private enterprises, as in Mauritania and Mozambique.[2] Finally, when compared with its group of peers (i.e., poor South Asian countries), Africa's performance has been significantly better in telecommunications access rates[3] and roughly the same in water and sanitation access rates and in kilometers of roads per capita. In electricity access rates, however, it has done much worse than its peers. The paper thus focuses on the electricity and water industries. It aims to analyze the costs and benefits of private participation in these public utilities.

In Africa, where it has been difficult to attract international investors, private participation into traditional public utilities has not been limited to investment. Many private firms have been involved into the management of utilities under leases or concession contracts without actually owning any asset in such firms. For instance, the World Bank has often favored performance management contracts, rather unsuccessfully. The paper extends the definition of Public Private Partnership

1. In Sub-Saharan Africa annual investment needs in infrastructure are estimated at USD 17-22 billion, while total annual spending is about USD 10 billion (World Bank 2005). The investment figure does not include annual operating and maintenance costs, evaluated at USD 17-18 billion. With operating and maintenance costs, the annual African investment requirement in infrastructure is estimated at 9% of GDP by Estache and Wodon (2006). The region's infrastructure financing gap thus is very likely to be around 5% of GDP.
2. See Blanc and Ghesquières (2006a), AFD-Hydroconseil (2002), AFD-Hydroconseil–SEURECA (2005).
3. Africa has the fastest growth rate of telecom penetration in the world at over 100% since 2001.

(PPP) to encompass all situations where the private sector is involved into the provision of utilities services, whether formally or not. We use the words "privatization" and "private participation" to refer to situations where a private operator provides utility services. This ranges from official contracts between government and international firms to *laissez-faire*.[4] The approach is pragmatic. It confronts the information which is available from empirical and case studies with the analytical tools available from regulation and privatization theory. The objective is to provide a critical overview of private sector involvement in water and electricity in Sub-Saharan Africa and try to indicate directions for successful reforms.

Assessments of privatization reforms vary widely depending on who is making them. As such reforms have led to improvements in the financial and operating performance of divested firms, and sometimes also to network expansion, some specialists tend to think that the reforms have been successful.[5] This positive appraisal contrasts sharply with the widespread perception among consumers in developing countries that the reforms have hurt the poor, notably through increases in prices and unemployment, while benefiting the powerful and wealthy. For example, surveys from Sub-Saharan Africa, post-communist transition states and South Asia show strong popular opposition to privatization policies (Kikeri and Kolo 2005).[6] In Africa, privatization reforms have been qualified as "re-colonization" due to the participation of foreign firms in many cases. The progress of democracy implies that governments have been threatened by the unpopularity of the reforms. In Africa, they also have been disappointed by the sluggishness of capital flows. Over the period 1992-2003, the continent managed to attract only 4% of total international investment in infrastructure (World Bank 2004).[7] Finally, private firms have generally been disappointed by the profits they can secure in developing countries. Discouraged by the unpopularity of their actions and the ensuing changes in policy,[8] many of them have retreated from utility services, notably in water and electricity. Examples include Veolia in Guinea, Saur in Mali, Hydro-Québec and Elyo in Senegal, and Biwater in Tanzania.

The contentment of the specialists is not easily reconciled with the dissatisfaction of consumers, governments and firms. Frustrations arose because expectations were too high. A World Bank survey of firms with international equity investments in developing country power sectors shows that 44% of the investors expected returns on equity of more than 16%.[9] Simultaneously, consumers were expecting better and broader services at lower prices, while governments were looking for fiscal revenue and large flows of private investment. Yet the productivity gains yielded by private sector involvement in public utilities management are at most 10% (more likely around 5%, as surveys in the United Kingdom suggest; see Newbery and Pollitt 1997). With the exception of the telecommunications industry, where private sector involvement has coincided with large productivity gains, the benefits generated by PPP reforms are not large enough to please taxpayers, consumers, firms' managers, investors, international organizations and governments all at the same time.[10] Does this mean that public private partnerships in developing countries have come to an end? The paper clarifies this issue.

4. Official forms of PPP contracts are Operation and Maintenance (i.e., management) contracts, lease or "affermage" contracts; Build and Operate; Build and Finance; Build, Operate and Transfer (BOT) and Concession contracts.

5. For instance, Nellis (2006) writes: "Privatization usually results in improved performance in the affected firms. Its macroeconomic impact is generally assessed as positive, at the very least in the sense of providing governments with opportunities, and being correlated closely with increased growth and aggregate welfare. Data from the best-studied cases show that privatization's impact on poverty and income distribution is, in many instances, negligible, and far less negative than popular perception would have it."

6. Similarly, the polling firm Latinobarometro, which conducts annual surveys of 19,000 people in 18 Latin American countries, found that 80% of respondents viewed privatization negatively in 2003.

7. Most international financing went to East Asia (44%) until the East Asian crisis, and thereafter to Latin America, Europe and Central Asia.

8. A major concern with privatization reforms has been governments' commitment capability. Many contracts have been renegotiated after a short period of time. A number of contracts have not been renewed, and some have simply been cancelled (Harris 2003).

9. The survey shows that investors' expected returns on equity range from 8% to more than 25%; 44% of respondents were seeking returns of more than 16% (Lamech and Saeed 2003).

10. In telecommunications, the productivity gains yielded by mobile technology have been very large, making PPP reform was easy to implement and sustain.

One major lesson from the analysis below is that, contrary to conventional wisdom, participation of private firms in the supply of water and electricity services is fairly common in Africa. This private involvement reflects the extreme weakness of African governments. Public utilities services are usually limited to big cities and wealthy neighborhoods. Yet everybody needs to have some access to water and energy. The irreducible part of demand has to be met, one way or the other. In rural areas, people rely on self-collected wood and water. In urban areas, the private sector is bridging the gap between public services and people's needs. Local private entrepreneurs have understood the profit they can make out of the fairly inelastic, irreducible part of demand. Water supply to the poor is in some African cities a textbook case of monopoly abuse. Another lesson from the analysis below is that in light of the financial constraint faced by African governments, letting private providers serve the less profitable segments of the market is a second-best solution. By contrast, profitable segments have to be served by the public utility at high prices. The utilities' goal should then be to extract large rents from the wealthy to subsidize access for the middle class and the poor. However, public utilities sell their output at subsidized prices, when they collect their bills at all. This reveals a problem of capture of such firms by the ruling elite. Improving the commercial performance of African public utilities is a matter of justice and efficiency.

In electricity, *laissez-faire* leads to severe penury on the continent. First, returns to scale are large, which implies that it is not possible to produce power at a reasonable cost on a small scale. Second, demand is conditional on access, because nobody owns electric appliances when he or she is not connected to the grid. This is a chicken and egg problem. Unconnected firms and households rely on traditional biomass energy. They do not own electric appliances and, as a consequence, are not very productive. The low level of demand and the limited size of the utilities' infrastructure are mutually reinforcing. The situation is so bad that, despite sustained economic growth, Sub-Saharan Africa's demand for power remains low and is growing only slowly. In practice, the growth of the sector is strongly dependent on supply. The level of investment required to improve access rates is high. Moreover, transmission networks and big generation facilities require public intervention and international cooperation when cross-border interconnection is needed. It would be unrealistic to believe that the private sector is able or willing to design, finance, and manage the electrification of Africa. Governments will have to play a central role and invest considerable resources in the process. In the meantime, self-sufficiency based on private generators and small privately owned and operated electricity networks will continue to close the utilities gap at a high cost.

The paper is organized as follows. Section 2 provides a brief description of the situation in the water and electricity sectors in Sub-Saharan Africa. Section 3 provides an overview of the classic microeconomic theoretical arguments in favor of privatization. Section 4 presents Auriol and Picard's (2002) results on macro-fiscal balancing and their implications for the provision of water and electricity in Africa. Section 5 concludes.

2. Electricity and Water in Africa

2.1 Electricity

Sub-Saharan Africa has the lowest per capita consumption of electricity in the world. The International Energy Agency estimates that 24% of the total population had access to electricity in 2002, as compared to 48% in comparable low-income countries (IEA 2004).[11] This implies that some 526 million Africans do not have access to electricity. The situation is worse in rural areas, where the average access rate has been estimated by Estache and Goicoechea (2005) to be as low as 8%. Whether these figures are accurate or not, it is undisputable that there is a severe penury of electricity in Sub-Saharan Africa.

This is a major concern because empirical studies show that energy consumption is one of the most significant determinants of growth.[12] For instance, in the portfolio of the International Finance Corporation (IFC) of the World Bank Group, the contribution of power projects to economic growth as measured by economic rate of return is greater than the rest of IFC's portfolio (Manibog *et al.* 2003). Since there is no substitute for electricity as a power source for lighting and for domestic and professional appliances, the lack of power acts as a brake on the African economy. Recent estimates, based on counterfactual analysis, suggest that on average growth per capita would have been roughly 1% higher if Africa had had East Asia's growth rate in electricity generation and in telephones per capita (Esfahani and Ramirez 2003), or alternatively, if it had had the infrastructure stock of South Korea (Calderon and Serven 2004).[13]

These quantitative results are confirmed by surveys collected by the World Bank as part of its worldwide Investment Climate Assessments. The questionnaire asks entrepreneurs for their assessment of the constraints on operation in their business. In all the cases available but two (South Africa and Mauritius), electricity is in the top 10 among 19 possible constraints. In fact, 40% of the firms surveyed list electricity as a major or very severe obstacle for the operation and growth of their business.[14] The constraint on the African economy is in fact much more severe than these statistics suggest, for two reasons. First, the problem is so bad that 40% of the firms surveyed own or share a generator. Once they are self-sufficient, firms tend to focus on other problems than electricity. In Kenya, for instance, 71% of the firms surveyed own or share a generator. Electricity thus ranks 9th (one of the "best" scores in the sample) among the 19 possible constraints. Second, the number of firms surveyed in each African country is fairly small (266 on average). The selection, which is based on tax records, targets firms from big cities and from the formal sector. Informal businesses and rural areas, which are the core of the Sub-Saharan economy, are not in the surveys. Since they cannot afford to own a

11. On a sample of 48 African countries, Estache and Goicoechea (2005) find the average access rate to be as low as 15% of the total population, as against 31% in other low-income countries.
12. In fact, energy was the leading driver of growth in fast-growing countries such as Brazil, Turkey and Korea (IEA 2004). For similar results on the US economy, see the study of the historical growth path since 1900 by Ayres, Ayres and Warr (2003).
13. Specific quantitative analyses on Africa are rare. Estache, Speciale and Veredas (2005) show that over the last 30 years, infrastructure investment accelerated the annual growth convergence rate by over 13% in the region.
14. African countries covered by the surveys are Benin, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mali, Mauritius, Senegal, South Africa, Tanzania, Uganda, and Zambia. On average, it takes 52.6 days to obtain an electrical connection; there are 50.5 days of electrical outages per year, generating losses evaluated at 9% of sales. See http://www.enterprisesurveys.org/icas.aspx.

generator, they bear the full cost of the lack of power. Lastly, the study ignores domestic consumers, who also suffer from the lack of electricity. Children in rural Africa walk hours to fetch wood and water. For instance, a study conducted in 2002-2003 in rural Guinea reveals that children aged 6 to 14 spend 4 hours per week on average collecting wood and water (Bardasi and Wodon 2006).[15] As pointed out by Estache and Wodon (2006), electricity has also an impact on health because it allows refrigeration. This is especially important for preservation of medicine and vaccines in clinics.

The total cumulative investment required between 2003 and 2015 to achieve the MDGs in Sub-Saharan Africa is estimated by IEA (2004) at US$46 billion. This implies annual investment of US$3.9 billion in constant dollars. Fay and Yepes (2003) estimate the annual investment needs between 2005 and 2010 at US$3.3 billion for electricity generation and US$2.9 billion for maintenance, which represent 0.7% and 0.63% of GDP respectively. This is less than the estimation by Estache and Yepes (2005), who put the total annual investment required to meet the MDGs between 2005 and 2015 at 1.9% of GDP (1.2% in investment and 0.7% in operation and maintenance). The discrepancy in the estimates is not surprising. It is hard to assess how much is needed when nobody knows how much is actually in stock or how much is invested. There are no reliable data on the level of expenditure in the sector. The total annual level of infrastructure expenditure in the region is estimated to lie between 2% and 4% of GDP.

Whatever the actual annual levels of spending in electricity, they are very unlikely to amount to the required 1.5-2% of GDP. The little evidence we have suggests that they are low. After a phase in the 1960s and 1970s when major investment projects in generation and transmission were conducted, investment in electricity came to a halt in the 1980s and 1990s. There are presumably several reasons for this. First, some of these projects were oversized, and have been suspected to be badly corrupt.[16] National and international organizations have been discouraged from investing in large infrastructure projects by the fear of financing "white elephants". Second, international donors and creditors, like the World Bank and the IMF, imposed structural adjustment programs as a condition for economic assistance in the context of the explosive debt crisis of the 1980s. The reforms were clearly intended to relax governments' budget constraint. Governments had to cut their spending in order to get aid. The budgetary adjustments seem to have been absorbed by the infrastructure industry. This is at least what is suggested by Estache and Wodon's (2006) study of a sample of 11 African countries for which data are available since the mid-1980s. The study shows that over the last 20 years government expenditures on infrastructure declined from 4.2% to 1.6% of GDP.[17] According to the authors, the adjustment would have been even more dramatic if the current situation were benchmarked against the 1970s. Finally, since the Asian financial crisis of 1997, private investors, major commercial banks and international organizations have retreated from the sector. In fiscal year 1998, for instance, 15% of total World Bank loans were allocated to electricity projects. One year later this figure had dropped to 1.5% (from US$3.2 billion to US$440 million). This withdrawal has been amplified by the weakening of the global infrastructure industry. Between June 2000 and October 2002, the stock prices of energy companies dropped by 88%. This crash was triggered by the Enron scandal in

15. Girls spend more time collecting water and boys spend more time collecting wood.

16. For instance, in 1973 Cote d'Ivoire commissioned a 176-megawatt hydroelectric facility on the Bandama River at Kossou. Its construction cost billions of CFA francs, as did the relocation of 85,000 Baoulé farmers. Lake Kossou was expected to cover a surface area three times the size of Lake Geneva and to double the country's electrical generation capacity. Yet poor rainfall during the mid-1970s prevented Lake Kossou from filling to its maximum capacity. Other serious droughts in 1983 and 1984 nearly dried it up. Turbines were shut down, and the country was obliged to rely once again on thermal power, which is much more expensive. Similarly, Kenyan President Daniel Arap Moi decided to build a huge dam on Turkwel River after his visit to François Mitterrand in Paris in 1981. Engineering studies were conducted by Sogreah and financed by French government. The project was estimated to cost FF 1 billion, but the contract signed with Spie-Batignolles, without any public tendering, was priced at FF1.8 billion. Rumors of corruption spread concerning Moi's French advisor Nicholas Biwott, especially when Foreign Affairs Minister Robert Ouko was murdered in 1990 after he launched an anti-corruption campaign (see http://www.politique-africaine.com/numeros/pdf/040130.pdf). In addition, deforestation caused siltation on the surface of the dam, which reduced electricity generation capacity and therefore the whole benefit of the project. More recently, Société Tchadienne d'Eau et d'Electricité signed in 2000 a management contract with Vivendi that came to an abrupt end in 2004 after four years of dubious practices by many actors, funds wasted by donors and rumors of corruption about the Sedigui oil project.

17. By contrast, government expenditures on health increased (from 1.6% to 2% of GDP) and education expenditures remained stable (above 4.5% of GDP).

the United States, which was followed by other scandals. Major international companies such as Enron and AES have therefore disappeared from developing country markets. A 2002 World Bank survey revealed that of the 50 private power firms surveyed, 52% were retreating from developing countries and only three continue to be interested (Lamech and Saeed 2003). The 50 firms were unanimous that PPPs were not important for them.

The investment trend has to be inverted, especially in generation and transmission. Improving the situation of the electricity sector should be a top priority of African governments and international agencies in the years to come.

2.2 Water

The situation in the water sector is better in both absolute and relative terms. Access to improved water sources, which is defined as the availability of at least 20 liters per person per day from an improved source within 1 kilometer of the user's dwelling, is estimated to be around 56% in Sub-Saharan Africa.[18] This level is reasonably good. First, it is roughly the same as that of its peers among the poor countries of South Asia. Second, when the situation in 2004 is compared with that in 1990, the percentage of the urban population having access to improved water sources has been stable at around 80%, while in rural areas the percentage increased from 36% to 42%. Since the population has grown during the period, these results are encouraging. Indeed, they are excellent by comparison with the access rate in the 1980s, when it was estimated that only one person in five had access to clean water. Finally, 56% is likely to be an under-estimate of the number of people who really have access to clean water because the WHO/UNICEF definition excludes vendor provided water, bottled water, and tanker truck water. Yet many people rely on vendors because they distribute water from improved water sources directly to their door. Vendors are providing a carrying service. Unless the tank used for transportation is contaminated, the water delivered is fairly safe. If carried water is added to the other sources, the share of the population having access to an improved water source is likely to be above 60%. This relatively good result reflects the fact that water services can be delivered at fairly small scale by informal firms. It is also the consequence of concerted international action, notably under the impetus of the International Drinking Water Decade (1981-1990). The launch of the second International Water Decade (2005-2015) should bring new improvements in access to clean water and sanitation around the world.

Requirements are still large. In Sub-Saharan Africa, only 16% of households are connected to a piped water network. This implies that 84% of Africans rely on self-collection or on small-scale providers for their water supply. In sanitation the situation is even worse. The WHO/UNICEF monitoring program estimated in 2004 that around 37% of Sub-Saharan Africans had access to sanitation. Only 8% of homes were connected to a sanitation network.[19] The total annual investment required in water and sanitation between 2005 and 2015 to meet the MDGs is estimated by Estache and Yepes (2005) at 1.8% of GDP (1% in investment plus 0.8% in operation and maintenance). Here again there are no reliable data on the actual level of expenditures in the sector. Yet the sum of expenditure required for water and electricity alone is higher than the total annual level of infrastructure expenditure in the region. The question of how utilities service should be financed is not settled. We explore some aspects of this issue below.

18. The term “improved water source” refers to a source that is likely to provide "safe" drinking water, such as a household connection, borehole, public standpipe, protected dug well, protected spring, rainwater collection. It does not include water from an unprotected well or unprotected spring, vendor provided water, bottled water, or tanker truck water. For more information on water supply and sanitation, see the joint WHO/UNICEF monitoring program at http://www.wssinfo.org/en/welcome.html. The 56% figure is available at http://www.wssinfo.org/en/233_wat_africaS.html.

19. See http://www.wssinfo.org/en/333_san_africaS.html.

3. Public Private Partnerships and Consumer Surplus

3.1 Productive Efficiency

The transfer from public to private ownership has generally been grounded in the poor economic performance of public enterprises. A critical problem induced by public ownership, first identified by Kornai (1980), is the lack of any commitment on the part of the government not to bail out or subsidize money-losing firms. This commitment problem is referred to in the literature on the subject as the *soft budget constraint* (interesting surveys are available in Kornai 2000 and in Kornai, Maskin and Roland 2002). Kornai (2001) provides evidence of the use of soft budget constraints by state-owned enterprises (SOEs) in developing countries. Since less efficient firms have been allowed to rely on the government for funding, they lack the financial discipline required for efficient management (Dewatripont and Maskin 1995 and Schmidt 1996). In Dewatripont and Maskin (1995) and Maskin (1999), the soft budget constraint is caused by the incompleteness of contracts between governments and firms. In these two papers, soft budget constraints affect the level of un-contractible investments made in firms by managers. By hardening firms' budget constraint, privatization helps to restore appropriate investment incentives and improves productive efficiency. Another part of the theoretical literature stresses that public ownership is associated with a lack of economic orientation in governments' objectives. For instance, in Kornai and Weibull (1983), Shleifer and Vishny (1996), Debande and Friebel (2003), governments are described as adopting "paternalistic" or political behavior as they seek to protect or increase employment; in Shapiro and Willig (1990), governments are simply malevolent. The main conclusion of this theoretical literature is that privatization improves the internal efficiency of firms.

Empirical evidence supports this result. Megginston and Netter (2001) offer an extensive review of the literature on the subject, covering 61 empirical studies at company level (both within and across countries). They conclude that privately managed firms tend to be more productive and profitable than public firms in both developed and developing countries. This does not mean that privatization always improves firms' performance. In three studies, looking at 204 privatizations in 41 countries, one-fifth to one-third of privatized firms have registered very slight to no improvement, and even, occasionally, worsening situations (Megginson and Netter 2001). In all other cases reviewed, privatization tends to improve firms' performance.

In developing countries, the gains from private sector involvement stem from better asset management and bill collection. This is, at least, what is reported by Manibog *et al.* (2003) in their review of the World Bank experience with private participation in the power sector. Over a five-year period, average plant availability in their sample increased 10% to 40%, outage indicators decreased by more than half, and the number of customers per employee increased 50%. Where private operators have taken over retail supply, they have drastically reduced payment delays, theft, and unpaid bills. For instance, unpaid bills were reduced from 30% to 12% for Compagnie Ivoirienne d'Electricité.[20] Similar results have been obtained in Latin America. For instance,

20. See Manibog et al. (2003). It had already dropped from 28% in 1990, the year of privatization, to 19.8% in 1992 (Deniau 1993). In this example, assets were not sold but just leased.

Andres, Foster and Guasch (2006), who studied the impact of privatization of electricity distribution in 116 cases in ten Latin American countries, show that privatization brings improvements in labor productivity, efficiency and product/service quality. These improvements in performance, which occurred in most cases in the transition period between public and private ownership, have been achieved through a substantial reduction in employment (by more than 40%). In water, results are somewhat comparable. For instance, a management contract between Suez and Johannesburg Water in 2001 for the suburb of Soweto in South Africa brought a dramatic decrease in leakages and unaccounted-for-water losses.[21] In Senegal, a ten-year affermage contract signed with Saur in 1996 allowed the water sector to reach positive financial results from 1999. Water production increased by 20% between 1997 and 2002, the number of customers increased by 50% between 1996 and 2003, and the network commercial rate (water paid for over water produced) improved from 68% in 1996 to 80% in 2006.[22]

3.2 Allocative Efficiency

It is indisputable that privatization tends to improve firms' asset management and commercial performance. In contrast, the assumption made by advocates of privatization, namely that efficiency gains are automatically transmitted to consumers, merits further discussion. The benefits of private involvement are real, but without major innovation they are not huge. For instance, Newbery and Pollitt (1997) estimate the welfare consequences of the privatization of the UK electricity sector. They conclude that there were permanent gains equal to 5% of previous total generation costs, but at least in the first few years following privatization the new private shareholders reaped most of the gains, and both government/taxpayers and consumers lost out.[23] Firms try to keep whatever cost reductions they generate for themselves. To understand this result, let us assume for a moment that the government's objective is to maximize the trade surplus. In a perfectly competitive market where price equates to marginal cost, it is true that consumers benefit from the efficiency gain generated by privatization. In industries characterized by increasing returns to scale, however, moving from public to private ownership does not offer a solution to the lack of competitive pressure. In the absence of government intervention, the number of firms that survive in equilibrium is small. Their rent-seeking behavior leads to high prices and allocative inefficiency. Such market imperfections hurt consumers. Empirical studies thus reveal that privatization results in lower prices and higher output in competitive industries, but not in oligopolistic ones (see Nellis 1999). According to Birdsall and Nellis (2002), "Steep price increases following privatization have been quite common in divested network or infrastructure industries, e.g. electricity and water and sewerage, and common but not universal in telecommunications." Prices are often increased before privatization in order to reduce the SOEs' financing gaps and attract buyers. This, for instance, was the case with electricity tariffs in Zimbabwe, Kenya and Senegal. In Senegal the government increased tariffs by 10% after reaching an agreement with Vivendi (see OECD-AfDB 2003). An unaccounted-for part of the price increases stemmed from the termination of illegal connections (Birdsall and Nellis 2002, Estache *et al.* 2002, OECD-AfDB 2003). Similarly, a recent study on the impact of privatization of electricity distribution in Latin America shows that privatization produced no changes in coverage and output once the authors controlled for firm-specific time trends. Although prices were hard to compare across companies, the results also suggest a rise in prices (Andres, Foster and Guasch 2006). Finally, a review of the World Bank Group's experience with private participation in the electricity sector shows that

21. A big operation against unaccounted-for-water losses (7 million cubic meters per month) was launched in 2003. First, networks 100 years or more old were rehabilitated; second, pre-paid meters were introduced and big communication campaigns were launched to educate people about the value of water. Over a four-month period, average household consumption dropped from 55 m^3 to 11 m^3 per month. Despite this good result, the municipal authorities chose in 2006 not to renew the five-year management contract with Ondeo (Blanc and Ghesquières 2006b).

22. More than 1 million people have been connected (see Carcas 2005).

23. Apparently the government underpriced the shares in order to ensure political success. The outcry in Britain concerning the windfall gains to shareholders in this privatization helped Tony Blair's Labour Party regain power. It also led to the imposition of a special tax on shareholder profits (see Birdsall and Nellis 2002).

tariffs have decreased for industry and commerce but have risen for other customers (Manibog *et al.* 2003). Experiences in the water sector show similar results. The improvements brought by the management contract for water provision in Johannesburg included a much higher rate of payment collection with the introduction of pre-paid water meters. Prices had been increased before private participation (since 1994) to finance massive investment, but in 2000 the South African authorities decided to provide 6 m^3 of water per household free of charge in the whole country as a safety net for the poorest. This social pricing policy was supposed to compensate for severe disconnection measures for those who do not pay their bills (for consumption above 6 m^3).[24] In Senegal, the water sector reached the financial break-even point through price increases of 3% per year between 1996 and 2002,[25] although social block tariffs have been introduced for small consumers.

Contrary to mobile telecommunications technology, the power and piped water industries still involve fixed connections between suppliers and customers. Since it is inefficient to duplicate transmission facilities, network industries are referred to as natural monopolies. Water networks tend to constitute *local* natural monopolies because each city constitutes a distinct market. At the national level there are usually a multitude of local monopolies with various types of contract and status. At the international level, however, the water industry is highly concentrated and there are only four major companies operating in Sub-Saharan Africa.[26] Electricity networks tend to constitute *national* monopolies because they are more efficient when operated at larger scale. Thus, only a small number of firms can survive in *laissez-faire* equilibrium. In the European electricity market, for example, economic liberalization has generated a wave of mergers and acquisitions leading to higher market concentration at both national and EU levels (Newbery 2002). More than two-thirds of the European market is now in the hands of eight large companies (Jamasb and Pollitt 2005).[27] Another feature specific to electrical networks is the strong interdependency of its parts. The interconnection of networks yields economies of scale, but it also complicates operations. It ties producers into a system where each individual action has repercussions for every other member of the network. This physical unity is creating major problems in the implementation of liberalization reforms. For instance, the failure of a single line, the Lukmanier line in Switzerland, deprived nearly 56 million people in Italy of power on September 28, 2003. This incident was preceded by the blackouts in Sweden and Denmark on September 23, 2003, and in the north-eastern United States and Ontario, Canada, on August 14, 2003. In the US case, it was clearly established that firms' behavior was at the origin of the problem. As predicted by theory, deregulation and competition in power generation led some firms to adopt a free-riding strategy in their management of reactive power, which in turn led to the blackout.[28]

In many non-OECD countries, these problems have discouraged governments from deregulating and liberalizing their domestic electricity markets. In a survey of 52 developing countries conducted by the World Bank in 2001, 31% of them had privatized their state-owned power facilities. This leaves roughly 70% of the sample under public ownership. It is worth noting that public ownership of the incumbent power firm does not preclude PPPs: 67% of the countries reviewed had established independent power providers (World Bank 2004). Similarly, a recent study on West Africa shows that six of the nine main power companies are fully public, while the other three have some private participation.[29] Finally, in light of the technical constraints imposed by management of a power grid, it seems natural that all African countries maintain a monopoly in transmission and distribution.

24. Blanc and Ghesquières (2006b).

25. The government has been criticized by financial institutions for having frozen prices since 2002.

26. The four major companies operating in Africa are Thames Water, Vivendi, Ondeo, and Saur. At the worldwide level there are two more: Anglia Water and Yorkshire Water.

27. According to the European Commission (2005), among the EU-15, concentration in generation and in retailing for the largest three firms is above 60% in 10 and 12 markets, respectively. The Europe-wide four-firm concentration ratio is 50%.

28. On the impact of deregulation on service quality in network industries, see Auriol (1998).

29. Muller (2003).

Since water and electricity networks are industries with increasing returns to scale, according to traditional regulation literature, a legal monopoly should be set to prevent wasteful duplication of investment. Moreover, the legal monopoly should be regulated to avoid the deadweight loss created by monopoly pricing. Under the complete contract approach adopted in the regulation literature (see Laffont and Tirole 1993), there is no difference between public and private ownership under regulated entry conditions and pricing. This result is important because it shows that ownership is not the key to the allocative efficiency problem; in industries with increasing returns to scale, *regulation* is the key. Empirical evidence supports this result. Using panel data for 51 developing countries over the 1985-2000 period, Zhang *et al.* (2002) study the effects of privatization, competition and regulation on the performance of electricity generation industry. They conclude that "the effect of privatization and having an independent regulator, separately, is statistically insignificant…; while the co-existence of these two reforms does seem to be correlated with greater electricity availability, more generation capacity and higher labour productivity." Similarly, the experience in industrialized countries shows that regulation, especially regulation of the pricing of access to bottleneck facilities, such as transportation and distribution networks, is a key component of successful liberalization reforms. The result is worrying because governments in developing countries have not been very successful in establishing regulatory institutions. They usually lack the human resources, experience and credibility needed to control large corporations.[30] This problem is compounded by the fact that, in practice, governments in developing countries are not focused on consumer surplus.

30. For instance in Latin America, the concessions that were granted to private operators following the divestiture of public firms were renegotiated after an average of only 2.1 years (see Laffont 2001 and Guash, Laffont and Straub 2002).

4. PPPs and Macro-fiscal Balancing (Auriol and Picard (2002))

4.1 Opportunity Cost of Public Funds

Governments pursue multiple objectives, such as the production of public goods, the regulation of non-competitive industries and the control of externalities, under a single budget constraint. Since the latter is usually binding, the *opportunity cost of public funds* (i.e., the Lagrange multiplier associated with the constraint) is strictly positive. Concretely, increasing investment in infrastructure such as electricity or water networks means decreasing the production of essential public goods such as national security, law enforcement, or commodities that generate externalities such as health care and education, or alternatively, increasing the level of taxes or debt. All of these actions have a social cost, which must be traded off against the social benefit. Symmetrically, when the government is able to tax an industry it can increase its investment in education, health care or other areas. The social benefit generated by this investment must be compared with the reduction in consumer surplus generated by taxes. Contrary to the price mechanism, government intervention is not, and cannot be, anonymous; it depends on the opportunity cost of public funds.

The opportunity cost of public funds, defined as the Lagrange multiplier of the government budget constraint, is higher when, all other things being equal, government revenue is lower.[31] Tax revenue as a proportion of GDP is typically much lower in developing countries than in rich countries. The tax revenue-GDP ratio for 1995, for example, was 36.1% for OECD countries (see official statistics on the OECD website) versus 18.2% for developing countries (based on a sample; Tanzi and Zee 2001). The difference in taxation level reflects the fact that taxation is a non-convex activity (see Warlters and Auriol 2005). Drawing the first euro of tax revenue involves sunk costs. For instance, transforming the informal sector into a formal one requires investment in education, so that all firms' managers are able to keep records. The government must also provide incentives for firms to register officially, train inspectors to control corporate activities, and so on. Developing countries are too poor to invest heavily in education, or even in their tax administrations. They cannot match OECD countries' direct taxation level. Other sources of public funds are crucial to them. This includes revenue from public firms. Symmetrically, subsidizing public utilities services is very costly. It must be justified by a high social return of the subsidy. The opportunity cost of public funds λ is thus positive. Each dollar that is transferred to the regulated firm costs $1+\lambda$ dollars to society.

Auriol and Picard (2002) study the impact of poor public budgetary conditions on privatization decisions concerning infrastructure and public utilities. The approach is normative and seeks to derive optimal policies. The paper offers a theoretical analysis of the relationship between a country's financial constraints and its optimal industrial policy. The opportunity cost of public funds summarizes the tightness of government budget constraints, with larger costs stemming from tighter constraints. Government assumes responsibility for a public firm's profit. It subsidizes the firm in case of loss and taxes it in case of profit. In contrast, managers and/or owners of privatized firms assume responsibility for the firms' cash flow. One benefit of

31. The opportunity cost of public funds is different from the marginal cost of public funds (i.e., the deadweight loss created by increasing marginally a specific tax). The marginal cost of public funds is a general equilibrium concept. It is relevant in the long run because it indicates the social cost (or benefit) of tax reform (for more on the marginal cost of public funds in developing countries, see Warlters and Auriol 2005). In the short run, however, the taxation level is more or less fixed. The Lagrange multiplier of the government budget constraint, referred to as the opportunity cost of public funds, is then the relevant parameter for cost-benefit analysis.

privatization is that it reduces government subsidies to money-losing firms.[32] However, privatization has a price. On the one hand, the government is not able to take advantage of positive cash flows in profitable firms. On the other, it abandons direct control of the firm's operations, especially prices, which has a cost to consumers. As explained earlier, empirical evidence shows that the output prices of natural monopolies increased as a result of privatization. Privatization in developing countries is thus treated in the model as the transition from public ownership with regulation of entry and prices to private ownership with price liberalization. One question addressed in the paper is whether the elimination of subsidies to unprofitable firms and the cash flow generated by the sale can compensate for the price distortion associated with privatization and the loss of revenue from profitable public firms. The answer is in the affirmative. When public finance matters, privatization without price control can be superior to benevolent regulation. To illustrate this important result, we present a simplified version of Auriol and Picard (2002). Although the latter considers both monopoly and duopoly structures, we focus here on the monopoly case. It is technically simpler and more realistic in the case of Sub-Saharan Africa.

Sub-Saharan Africa has the lowest electricity and water demand per capita in the world. Both the water and power industries are operating below efficient scale. For instance, Tovar and Trujillo (2005) study electricity generation between 1998 and 2001 in 13 countries (mostly East African). They show that inefficiencies of scale are of the order of 24%. This result militates in favor of more concentration in the electricity industry, and against reforms aimed at unbundling existing African utilities.[33] In practice, unbundling has been tried only in Uganda and Kenya, without success.[34] Similarly, water utilities are operating below efficient scale. Estache and Kouassi (2002) study 21 African utilities over the 1995-1997 period. They found that the average efficiency level, which is correlated with the size of the utility, is 54%. Lastly, Tynan and Kingdom (2005) study 270 water and sanitation providers worldwide, including 83 African ones. In the African cases they found very significant scale efficiency effects. Doubling the population served increases operation and maintenance costs by only 61%. These results militate in favor of more concentration and integration. Water utilities have to expand their services by connecting more households and firms in areas where they are already operating. Electricity utilities need to grow and to absorb private sub-networks, when these exist. This integration strategy will increase their productivity and decrease their costs.

4.2 The Model

On the production side, the cost function includes a sunk cost $K>0$. This cost is so large that the market has a natural monopoly structure. The firm must make the investment K before discovering its idiosyncratic marginal cost c. The fixed cost $K>0$ is common knowledge; the marginal cost c is private information of the firm's manager. The government, which does not observe c, has an *a priori* assumption concerning the parameter: it is assumed to be independently drawn from the support [illegible] according to a uniform distribution. With a production level of Q, the firm has the following cost function: $C(Q)=K+cQ$. It maximizes the profit: $\Pi(Q)=P(Q)Q-cQ-K+t$, where $P(Q)Q$ is the sales amount and t is the net transfer that it gets from the government (subsidy minus tax).

On the consumer side, demand is linear. The inverse demand for $Q>0$ units of the commodity is given by: $P(Q)=a-bQ$, where $a>0$ and $b>0$ are common knowledge. The gross consumer surplus, defined as the integral of the inverse demand function, is therefore $S(Q) =aQ-0.5bQ^2$. The government is utilitarian. It maximizes the sum of consumer and producer surpluses minus the social cost of transferring

32. For instance, the privatization commission of Burkina Faso reported that government subsidies to SOEs dropped from 1.42% of GDP in 1991 to 0.08% of GDP in 1999 as a result of privatization (OECD-BAD 2003).

33. World Bank reforms to unbundle existing public electric utilities in Europe and Central Asia, which share many features with African utilities, have been very unsuccessful. Reconcentration into larger entities has been necessary in several cases (Manibog *et al.* 2003).

34. In Kenya, electricity production and distribution were separated by the Electricity Act in 1997. Since the performance of Kenya Power and Lighting Company (KPLC), which is in charge of power distribution, has been very poor, notably in access rates (only 15% of the population) and financial performance, the Energy Sector Recovery Project in Kenya (2004) is focused on pragmatic objectives (commercial support, management contract signed with KPLC). It is no longer contemplating introducing competition in the distribution sector.

public funds to the firm. The transfer to the firm can be either positive (i.e., a subsidy) or negative (i.e., a tax). Government's objective function is: $W=S(Q)-cQ-K-\lambda t$, where λ is the opportunity cost of public funds. Under public ownership the government's control rights on prices and quantities are associated with accountability for profits and losses. That is, it must subsidize the firm in case of losses, whereas it taxes the firm in case of profits. In contrast, under private ownership the government imposes no control on prices and quantities, and it takes no responsibility for the firm's profits or losses. In other words, transfers are ruled out between the government and the private firm: $t^{PM}=0$.[35]

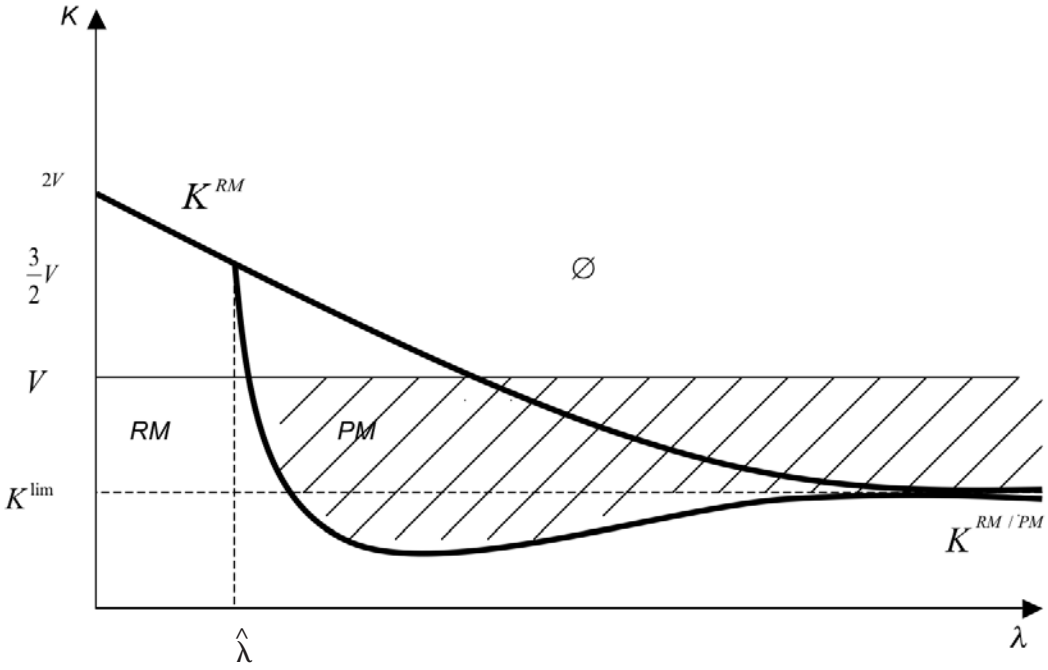
Under private ownership, denoted *PM*, the firm pays the sunk cost *K*, and chooses the *laissez-faire* monopoly quantity; $Q^{PM} = (a-c)/(2b)$. Under public ownership, the government pays the sunk cost *K*, and chooses the regulated monopoly quantity, denoted *RM*, which under the situation of asymmetric information is: $Q^{RM} = (1+\lambda)/(1+2\lambda)\ (a-c_V)/b$, where $c_V = c(1+2\lambda)/(1+\lambda)$, is the total marginal cost of service provision, that is, it includes the cost of production, *c*, plus the cost of information revelation, $c\lambda/(1+\lambda)$. It is straightforward to check that when $\lambda=0$, $Q^{RM}=Q^*$, which is the first-best quantity obtained when price P^{RM} equates to marginal cost *c*. Symmetrically, when λ approaches infinity the regulator chooses the quantity and price of the monopoly, evaluated at the virtual cost $\lim_{\lambda\to\infty} C_V=2c$, so that $Q^{RM}=Q^M(2c)$ and $P^{RM}=P^{PM}(2c)>P^{PM}(c)$. Let *E* denote the expectations operator. One can check that the *ex ante* welfare level under private ownership is $EW^{PM}=3/2V-K$ where $V=E(a-c)^2/(4b)$ is the expected gross profit of the monopoly (i.e., the *ex ante* firm profit level is $E\Pi=V-K$). Similarly, the *ex ante* welfare level under public ownership is $EW^{RM}(\lambda)=(1+\lambda)\{(2+2\lambda)/(1+2\lambda)V^{RM}(\lambda)-K\}$, where $V^{RM}(\lambda)=E(a-c_V)^2/(4b)$ is *V* evaluated at c_V instead of *c*. The optimal choice between public and private ownership is obtained by comparing the two welfare functions. The optimal industrial policy corresponds to privatization if and only if $EW^{PM} > EW^{RM}(\lambda)$.

Figure 1 summarizes Auriol and Picard's (2002) results for the monopoly case. On the horizontal axis is the opportunity cost of public funds. For λ close to *0*, the government does not care about transferring funds to the firm. It focuses on the net consumer surplus (i.e., for $\lambda=0$ the government's objective function is $W=S(Q)-cQ-K$). Where λ is large, the government gives more weight to transfers and less to consumer surplus. On the vertical axis is the sunk cost K. The curve K^{RM} represents the limit values of *K* above which the regulated monopoly is no longer valuable (i.e., such that $EW^{RM}<0$). The curve $K^{RM/PM}$ represents the limit values of *K* under which the regulated monopoly is preferred to the private monopoly (i.e., such that $EW^{PM} < EW^{RM}$). In the hatched area denoted *PM*, the private unregulated monopoly is the optimal industrial policy; in the white area denoted *RM*, the optimal policy is the public regulated monopoly.

Figure 1 shows that the privatization of natural monopolies with price liberalization is superior to benevolent regulation under public ownership for intermediate values of λ (i.e., for $\lambda > \hat{\lambda}$, $K^{RM}(\lambda) > K^{RM/PM}(\lambda)$). The relevance of the privatization result depends on the meaning of an "intermediate" value. If it is very high, in practice privatization is never optimal. Auriol and Picard (2002) rely on simulations to compute the threshold value. Depending on the technological uncertainty (i.e., the marginal cost distribution), it lies in the interval [0.35, 1.14]. In developed economies, λ is mainly equal to the deadweight loss accrued to imperfect income taxation. It is assessed to be around 0.3 (Snower and Warren, 1996). In developing countries, low income levels and difficulties in implementing effective taxation programs are strong constraints on the government's budget, which leads to higher values of λ. As a benchmark case, the World Bank (1998) suggests an opportunity cost of 0.9. The value is much higher in countries that are heavily indebted or close to financial bankruptcy. This suggests that the right side of $\hat{\lambda}$ corresponds to the range of opportunity costs prevailing in developing countries. In other words, advanced economies tend to be on the left side of $\hat{\lambda}$ in Figure 1, and developing economies on the right side. Under the assumptions underlying the theoretical analysis, optimal industrial policies for rich countries are different from those for poor countries.

35. This assumption is an artifact of the model. Private firms do not pay tax on profit, but in Auriol and Picard (2002) they might pay an entry fee. In a static context these two forms of taxation are equivalent. For the sake of simplicity we have dropped it here.

Figure 1. Optimal Industrial Policy (based on Auriol and Picard 2002)



4.3 Unprofitable Segment

The unprofitable part of the market is depicted on the upper part of Figure 1. For *K* greater than *V*, the private firm makes a loss. When the profitability of a market segment is negative, the optimal industrial policy involves public ownership for the low value of λ and no production for the high value. The public ownership case corresponds to the white area denoted *RM*, which is under the curve K^{RM} and above the profitability line *V*. The no production area, which is labeled Ø, is above the curve K^{RM} and the profitability line *V*. This result helps to explain the difference in infrastructure level between rich and poor countries. Electrification or connection to piped water in remote, low-density areas is achieved through subsidies in advanced economies.[36] In poor countries, the opportunity cost of the subsidies is higher than the social return on the investment, making the latter simply impossible. This also implies that governments in developing countries should get rid of their unprofitable public firms. Accordingly, one-third of all privatizations to end-1996 in Africa were liquidations or asset sales of unprofitable firms (Sarbib 1997). It is worth noting that for the area which is comprised between the curve $K^{RM/PM}$ and K^{RM}, welfare would be higher with a private monopoly than with a public one. The problem is that a private firm is not willing to serve the market because it will make a loss. NGOs and local governments might find it useful to subsidize private firms to serve this unprofitable segment._

4.4 Low Profitability Segment

When *K* varies between the limit value K^{lim} (i.e., the value of $K^{RM/PM}$ when λ goes to infinity) and the profitability line *V,* the profitability of the market segment is positive but low. The optimal industrial policy then is monotone in the opportunity cost of public funds. For low values, public ownership is superior to privatization, while the reverse is true of high opportunity cost. Governments with abundant fiscal

36. The subsidies can be financed with public funds when these are sufficient (see Auriol and Picard 2005) or by the wealthiest segment of demand (i.e. through cross-subsidies). It is worth noting that OECD countries have traditionally relied on cross-subsidies. Taxation by regulation arises because governments want to implement social programs, but are unwilling (unable) to increase general taxes. Cross-subsidies call for close monitoring of firms' pricing policy.

resources subsidize the investment and let consumers use it at marginal cost. This policy maximizes the consumer surplus, which in the case of low opportunity cost of public funds is equal to utilitarian social welfare. On the other hand, when the opportunity cost of public funds is high, the government objective function is tilted toward transfers. Subsidizing infrastructure, which has a low social return, is simply too costly. Privatization is then an appealing alternative to public provision. Consider the limit case where the government cannot finance infrastructure such as a small water network or generation facility. If a private firm is eager to do it in exchange for the freedom to charge monopoly prices, it is optimal to let the firm do so. Indeed, it is better to have privately owned and operated infrastructure, even with the monopoly distortion, than no infrastructure at all. This result still holds true when the government is able to finance the infrastructure.

Since the opportunity cost of public funds is high in developing countries, the latter implement industrial policies that differ strongly from those favored in developed economies. There is a public good aspect and externalities associated with sunk-cost investment such as infrastructure. As recommended by standard economic theory, wealthy nations subsidize the construction of most infrastructure and let people use it at marginal cost. With low opportunity cost of public funds, this policy maximizes welfare. In contrast, countries plagued by financial problems cannot follow this strategy. Private provision of utilities services is hence fairly common in developing countries. PPPs between governments and international firms have attracted a great deal of attention. In Sub-Saharan Africa, the preferred arrangements for formal private participation in the water industry have been concession and lease contracts (PPPs with risk sharing for rehabilitation and extension of existing infrastructure). In the electricity sector, Estache and Wodon (2006) report that over the 1990-2003 period greenfield contracts (BOT) were the most popular type of PPPs. However, formal contracts are only the tip of the iceberg.

There are thousands of small-scale providers of water and electricity services operating informally (see the Appendix for an overview of the structure of water and electricity PPPs). They have not received much attention, yet they are filling the service gap in low profitability segments. Small-scale providers of energy have been documented in Cote d'Ivoire, Senegal, Somalia, South Africa, Tanzania, Uganda, Ethiopia, Ghana, Kenya, Mali, Mozambique, and Zimbabwe (Kariuki and Schwartz 2005). Because it is easier to produce efficiently at small scale, the phenomenon is even stronger in the water sector (i.e., it constitutes a local natural monopoly). In Maputo, for instance, a recent study shows that some 100 local informal entrepreneurs have invested in 200 small networks. Their access rate in the two poorest quintiles is comparable to the access rate achieved by the national operator, Aguas de Mozambique, even though they receive no subsidy for their operation.[37] Small-scale operators play a very important role in periurban areas of capital cities. A recent survey estimates that nearly half of urban dwellers in Africa rely on such private services (mainly point source systems or vendors). Small-scale providers of water have been documented in Angola, Benin, Burkina Faso, Cote d'Ivoire, Ethiopia, Ghana, Guinea, Kenya, Mali, Mauritania, Mozambique, Niger, Nigeria, Republic of Congo, Senegal, Somalia, South Africa, Sudan, Tanzania, Uganda, Zambia, and Zimbabwe (Kariuki and Schwartz 2005). As predicted by theory, they are bridging the public service gap at a high cost. They are unregulated and receive no subsidies, so that the price of their service is much higher than the public utilities' price. Since they are serving the middle class and the poor, these groups pay more for a cubic meter of water than the rich. For instance, a case study in the city of N'Djamena shows that the corporation of water carriers is well organized. It behaves as a cartel and applies monopoly pricing. On average, the water is sold with a markup of 3.5 times the price at which it is purchased from the regulated public utility (Bernadac 2005). Similarly, a study in the city of Niamey shows that the average price paid by the poorest 20% of households is roughly 2.6 times higher than the price paid by the richest 20% (Bardasi and Wodon 2006).[38] Empirical

37. AFD-Hydroconseil-SEURECA (2005).

38. Households pay on average CFAF 645/m^3 in the first quintile, CFAF 541/m^3 in the second, CFAF 509/m^3 in the third, CFAF 422/m^3 in the fourth, and CFAF 249/m^3 in the fifth.

studies show that there is a strict negative relationship between income and the price per cubic meter of water.

Economists and international organizations have hitherto overlooked these private, often informal, firms in water and electricity sectors. For the future, it might be useful to conduct systematic studies on the extent of their services. The objective should be to target some of these local providers and to encourage them to expand their services and to become formal, notably by lending them money,[39] while in exchange controlling their prices. A good example can be found in small cities of Mauritania, where local operators have signed three-year delegated management contracts with a central body, ANEPA. Thus 300 independent small-scale operators serve more than half of the population, have invested $5 million, and outperform water services in larger cities (managed by the national water company) on access rates and other key indicators.[40]

4.5 Profitable Segment

When the public utility is profitable, the optimal industrial policy is non-monotone in the opportunity cost of public funds. This result is a consequence of the difficulties encountered by developing countries, particularly in Africa, in attracting investors while auctioning off profitable state-owned enterprises (SOEs). Indeed, country risk analysis is very important in global investment strategies because it forms the basis for determining expected future returns on investment. Since the perception of business risk is higher in poor countries, as illustrated by the International Country Risk Guide, this negatively affects the supply and cost of international capital for these countries. SOEs are generally sold at a discount (see Birdsall and Nellis 2002). With under-priced public assets, Auriol and Picard (2002) show that the optimal policy is non-monotone in the opportunity cost of public funds. For low and high opportunity cost scenarios, public ownership is preferred to privatization. The reverse holds true for intermediate opportunity cost.

When the opportunity cost of public funds is low, the government sets prices close to marginal cost and subsidizes the regulated firm to cover fixed costs. Rises in the opportunity cost of public funds increase the social cost of such transfers. The government prefers to let a private firm take over for intermediate values. Finally, for large values the government, which focuses on revenue, prefers to keep profitable firms public rather than to sell them off. Prices are set close to the private monopoly level in order to maximize profit and thus government revenue. It is wrong to believe that the governments of advanced economies do not care for the revenues generated by their utilities. The fiscal argument works for every country in the world.[41] The difference between them lies in the weight given to this argument. As developing countries are not able to tax as efficiently as advanced economies, they need the additional revenues more badly.[42] It would be unfair and wrong-headed to ask them to focus on their consumer surplus, when advanced economies have always relied on their utilities for fiscal resources.

The non-monotonicity result has important policy implications for the profitable segment of the water and the electricity industry. While divestiture of the profitable public firm, or of its profitable segments, may be optimal in developed countries, it is not necessarily ideal in developing countries, where budget constraints are tight and market institutions are weak. Indeed, restructuring of public utilities, aimed at encouraging private participation in developing countries, has resulted in market-skimming policies. The private firms took

39. Kariuki and Schwartz (2005), who survey 400 documents (articles, reports, case studies), show that small-scale private providers of water and electricity are severely credit-constrained.

40. See AFD-Hydroconseil (2002). See also AFD-BPD-Hydroconseil (2006).

41. In the United States, for example, a federal excise tax on local and long distance telephony services was created in 1898. It has been repealed occasionally and re-enacted ever since. The opponents of the tax argue that it is regressive and distortive, while its proponents insist on the need for revenues in order to reduce federal budget deficits. It is hard to get around this argument: at a tax rate of 3%, tax collection reached US$5.185 billion in fiscal year 1999 (reported in *Budget of the United States Government, Fiscal Year 2000*).

42. For instance, over the 1990-95 period, revenues collected from public firms amounted to 8% of GDP in Bolivia, 2.2% in Brazil, 5% in Chile, 1% in India, 3% in Mexico, 3% in Peru (World Bank 1998). "On the whole this non-tax revenue is more important for developing as opposed to industrial countries, comprising about 21% compared to 10% of total revenue" (Burgess and Stern 1993, p. 782).

over large urban areas, while abandoning unprofitable rural segments. Consistently with theory, the result has been an increase in the fiscal costs of the sector when the profit centers used to finance cross-subsidies are handed over to the private sector (Estache and Wodon 2006). There is also significant evidence of higher net fiscal cost associated with the privatization of public utilities' profit center in Latin America (Trujillo *et al.* 2003). This problem is reinforced by the fact that breaking up or unbundling African public utilities is inefficient. They are already operating at a sub-optimal scale.

Based on the normative analysis, the biggest concern with African public utilities is their commercial and pricing policy. In line with theory, they are focusing on the wealthy segment of demand, but contrary to the paper's recommendation they do not make a profit out of it. Depending on the value of λ they should charge a price close to, or even above, the private monopoly price. In fact, public utilities services are subsidized, which is in total contradiction with the results above. It signals a problem of capture of public utilities by the local elite. This is especially striking in the water sector. A recent study of 26 African countries shows that the connection rate to piped water is almost 0% in the first three income quintiles in 21 countries (see Diallo and Wodon 2005).[43] This figure is consistent with the statistic produced by the WHO/UNICEF water monitoring program, which put at 16% the share of Africans with access to piped water.[44] Since the people connected to the water network are wealthy, subsidizing piped water services in Sub-Saharan Africa clearly means subsidizing the rich. A survey of papers and case studies on small-scale private service providers shows that the average price per cubic meter in Africa is less than US$0.5 for utilities and around US$4.75 for carter vendors (Kariuki and Schwartz 2005). It has been estimated that water utilities need to charge at least US$1 per cubic meter in developing countries to cover operation, maintenance and most investment needs (Foster and Yepes 2006). The financial gap is closed with scarce public subsidies and the suppression of investment in maintenance and in network extension. With the poor paying up to 10 times the price paid by the rich, doubling the price of piped water in Sub-Saharan Africa and collecting the bills is not simply a matter of efficiency, it is also a matter of justice.[45]

We conclude that if public water utilities want to improve efficiency and equity, they need to subsidize access to the network for those who are not connected.[46] Simultaneously, they need to raise substantially the price per cubic meter of water and make users, including the government and public administrations, pay their bills. Indeed, commercial problems are acute in African utilities.[47] There is no point in revising tariff structures if the firms do not first improve their commercial performance. Since private firms are more efficient than public ones in commercialization, it might be profitable for public utilities to outsource the distribution segment to the private sector. Private involvement in distribution reduces theft, unpaid bills (notably by the government), and losses.[48] Private participation also increases labor productivity. For instance, Tremolet (2006), who studies eight water utilities in Africa, finds that the best performer is

43. It is nil in the first quintile. In the second quintile it is nil in 23 countries. In the third quintile (the middle 20% on the African income scale), it is still nil in 18 countries, and below 3% in three additional countries; it is 26% in Cote d'Ivoire, 17% in the Comoros, 7% in Kenya, 9% in Namibia, and 16% in South Africa. In the fourth quintile, connection rates are still below 5% in 19 countries; the access rate in the 7 remaining countries is above 20%. Only in the fifth quintile does one find positive access rates in all countries.

44. See http://www.wssinfo.org/en/233_wat_africaS.html.

45. Such a price increase is possible. In Uruguay, for instance, residential water tariffs were raised in nominal terms at an average annual rate of 25% (15% in real terms) over the 1997-2003 period (Foster and Yepes 2006). It is easier in Africa, where only the rich are connected.

46. There is no positive relationship between water consumption and income. For instance, Nauges and Van Den Berg (2006) estimate water price elasticity in southwest Sri Lanka. For households that use piped water, they conclude that the elasticity is not statistically different between income groups. Similarly, a study of eight Latin American utilities shows that consumption is not well correlated with income (Foster and Yepes 2006). This explains why increasing block tariffs (IBT) perform so badly in term of targeting. Studies on Latin America and South Asia suggest that the IBT structure delivers only 20% of the subsidies to the poor. Inclusion and exclusion errors are both very large. To help the poor, it is more efficient to subsidize access.

47. In Bangui (Central African Rep.), SODECA in water and ENERCA in electricity manage to charge only 30% of the amounts they produce. If this rate were improved to a reasonable 70%, more than €1 million in water and €5 million in electricity would be saved annually. Similarly, in Kinshasa (Dem. Rep. of Congo), the collection rate of REGIDESO (water) is 35% and that of SNEL (electricity) 30%.

48. If there is strong political will, commercial performances of public utilities can be improved without any private involvement, as in the cases of PPWSA in Cambodia and SONEDE in Tunisia.

Senegal, where the public firm SONES is in charge of capital management, investment and planning, with the private firm SDE in charge of operation and distribution. The SONES/SDE entity serves the highest number of people (5 million with 360,000 connections, as against 180,000 on average in the sample), with a ratio of 3 employees for 1,000 connections (as against 10 on average). It is also the only utility that achieves capital and operating cost recovery.

In electricity the pricing situation is somewhat better. Comparing the two industries, Foster and Yepes (2006) estimate that 69% of low-income countries achieve some degree of cost recovery in electricity, as against only 12% in water. This difference is explained by the fact that electricity tariffs are proportionally higher than water tariffs. Average electricity tariffs in high-income countries are twice as high as those in low-income countries; in water they are nine times higher. Thus, most African countries' tariffs are too low to recover fully the costs. To increase investment capacity, public utilities' tariffs need to be increased. This is possible. For instance, in Rwanda the price per kwh has been doubled by the national electricity firm. Electricity utilities should also develop non-linear tariffs for large customers, such as peak load pricing, to smooth demand and to deal more efficiently with the penury of power. Non-linear tariffs are also useful to shield the poorest consumers from the burden of the necessary price rises. Contrary to water, there is some evidence of a positive relationship between consumption of electric power and wealth. This implies that it is somewhat possible to target the poor. To protect its poor customers from the doubling of the price, the Rwandan national electricity firm is considering implementing an inverted-U block tariff (IUBT) structure: the first block would be subsidized by the second block, and the third block would be priced at cost recovery level. Finally, non-linear tariffs are useful in maximizing profit. Sophisticated pricing policies require accurate metering of consumption.

African governments will have to invest in electricity infrastructure in the years to come. The private, informal sector is not equipped to produce and distribute power on an efficient scale. Since public finances are very tight, they will also have to play an important role of coordination among the different potential sources of funding. These include consumers, NGOs, aid agencies, international investors, and local private entrepreneurs and investors. For instance, the largest source of external financing in many African countries is migrant remittances (World Bank 2006). Tapping some of these funds could be very useful. However, investors need to believe that they will not be expropriated from their investment once it is sunk. Moreover, public firms need to be healthy, with good financial prospects. This requires sound pricing and marketing policies. A success story is the partial sale of SEEG, the public electricity and water utility of Gabon, to local firms (19%) and individual Gabonese (15%). Because the firm had a good reputation, the demand for the shares has been so high that the government has been obliged to ration their allocation.[49] Côte d'Ivoire is another success story of PPP with local participation (see Appendices A1 and A2). Similarly, a recent study on infrastructure financing in developing countries, drawing on more than 2,700 projects in the World Bank's PPI Database for 1998-2003, determined that investors from developing countries investing regionally are very important in Africa (more so than in other regions). These foreign firms are accounting for 38% of all investment by value. They are also the largest in terms of investments per project at US$104 million, compared to US$58 million from local investors and only US$35 million from developed country firms. They are dominant in telecoms and energy projects, but not at all in water. In energy, for instance, YTL Corporation of Malaysia has invested in Zimbabwe, and Alrosa of Russia in Angola. The regional investors are mainly from South Africa. Eskom Enterprises has invested in Zimbabwe and Uganda, NetGroup Solutions has signed a management contract in Tanzania, and SAD-ELEC has signed one in Lesotho (Schur 2005). Such investments from other developing countries, especially African ones, have to be encouraged. Regional investors have a better perception of the business risk they face. They are asking for lower rate of return on their investment and their involvement is easier to defend politically.

49. AFD (2006). This also raises the issue of independent regulation. President Omar Bongo combines the roles of regulator and shareholder (he owns 3.5% of SEEG). Some analysts are concerned by the excessive amount of dividends paid to shareholders. They are unsustainable.

5. Conclusion

As suggested by theory, utilities services provision is more market-oriented in Sub-Saharan Africa than in OECD countries. This reflects the extreme weakness of African governments. Success stories in Sub-Saharan Africa are generally demand-driven. Examples of this include the penetration of mobile telephony and water provision to the middle class and the poor. Since these population groups are not connected to the public utility, they generally receive no subsidy. They get a service because they are ready to pay for it and because local businesses are ready to invest to provide it. In light of the financial constraint faced by African governments, letting such businesses serve freely the less profitable segments of the market is a second-best solution. For instance, in small Mauritanian cities access rates are higher than in the capital because of small private entrepreneurs' involvement.[50] Such involvement is possible because water services can be provided efficiently on a fairly small scale. In electricity, however, the returns to scale are large. As illustrated by the continent-wide penury of electrical power, *laissez-faire* is very inefficient. Self-sufficiency based on private generators and small, privately owned and operated electricity networks closes the utilities gap at a high social cost. International organizations and donors need a pragmatic approach to the problem of the development of poor countries' infrastructure. To date, they have tried to attract international investors at high restructuring and financial costs.[51] Not only have the reforms been expensive to design and implement, they have often been unsuccessful as well.[52] For the future, it is more efficient to focus on public utilities' commercial performance. This is a first step to collecting public and private funds.

Reform of public utilities must take into account the fiscal constraint faced by African governments. In profitable market segments, allocative inefficiency combined with the critical budgetary conditions found in most Sub-Saharan countries argue in favor of public ownership with high pricing policies. This is an effective way of combining regulation of the firm with a maximum level of taxation. However, if African utilities focus on the wealthy segment of the demand, they sell their services at a subsidized price. Moreover, they show no great interest in collecting bills. This suggests that they have been captured by the ruling elite. Informing the people through the media of this political problem might help to raise prices to cost-recovery level. Increasing the quality of the service, notably by decreasing the number of shortages, might also help the wealthy to accept higher payments. This is important because healthy public firms are necessary to attract investors – especially local and regional ones, which are the largest source of private investment in Africa – and to increase service coverage. Since water and electric utilities are operating below efficient scale, connecting more people is the best way to increase consumer surplus and equity simultaneously. Instead of subsidizing prices, African public utilities should subsidize new connections.

50. AFD-Hydroconseil (2002) and AFD-BPD-Hydroconseil (2006).

51. For instance in Eastern Europe the World Bank spent US$100 million on technical assistance for reforming, without success, the power sectors in Ukraine (Manibog *et al.* 2003).

52. A striking example is EDM in Mali, where a management and a concession contract have successively been signed and terminated over a 10-year period. The result is a tremendous backlog in water and electricity. As Tremolet (2005) writes, "The conflict between the private operator and the Malian Government regarding the terms of the contract and EDM's obligations has mobilized a considerable amount of time and resources by comparison with the overall impact of EDM's contribution […] EDM only provides services to 10% of the Malian population."

Appendix

A1. Typology of Private Sector Participation in Water Utilities

1. International Operators in Big Cities (contract[53] in operation or to be signed):

- Côte d'Ivoire (a concession contract was signed with Saur in early 1959 for Abidjan, and has evolved into various PPP arrangements until a 20-year affermage contract was signed in 1989 for all cities)
- Senegal (affermage with concession elements signed with Saur in 1996; renewed in 2006)
- Gabon (20-year concession contract signed with Veolia in 1999)
- Mozambique (15-year lease contract signed in 1999 with Saur / Aguas de Portugal / private Mozambican investors. Saur withdrew in 2002)
- Niger (affermage contract signed with Veolia in 2001)
- Morocco (Ondeo in Casablanca / Veolia in Rabat-Salé and Tanger-Taitouan)
- *Zambia (Copper Belt: management contract with Saur in 2001. Still in operation?)*
- *Rwanda (5-year management contract signed in 2003 with Lahmeyer)*
- Cameroon (Public Offer phase for affermage)
- Madagascar (Public Offer phase for affermage; *management contract with Lahmeyer still in operation)*
- *Ghana (5-year management contract signed in 2005 by publicly owned operators Vitens / Rand)*
- *Burkina Faso (5-year management contract in 2001 with Veolia / Mazars & Guérard)*

2. International Operators in Big Cities (contract[1] terminated or not renewed)

- Mali (Management contract in 1995 with Saur/EDF/Hydroquebec/CRC-Cogema terminated in 1997; Concession contract signed with Saur in 2000 for Bamako and 16 urban centers; terminated by Saur in 2005)
- Guinea (A lease contract was signed with Saur / CGE in 1989 for Conakry and 16 cities; terminated by government in 2002)
- Central African Republic (affermage contract signed with Saur in 1991; terminated by Saur)
- *Chad (Veolia signed a 30-year management contract in 2000 which was supposed to evolve through a privatization process; terminated by Vivendi in 2004)*
- Cape Verde (50-year concession contract signed with Aguas de Portugal; in crisis)
- Tanzania (Dar es Salaam: the lease contract signed with Biwater in 2003 was terminated by the government in 2005)
- *Uganda (management contract with Ondeo 2002-2004 for Kampala)*
- *South Africa (Johannesburg: 5 year management contract with Ondeo in 2001)*
- *Sao Tome & Principe (Safege, subsidiary of Suez/Dumez, signed a management contract in 1992 which was terminated in 1995*

3. International Operators in Small Cities (contract1 still in operation):

- *Kenya (Malindi – O&M contract signed with Gauff in 1995, followed by a management contract in 1999)*

53. Operating and Maintenance or Management contracts in italic.

- South Africa (*Queenstown: O&M contract signed with Ondeo* in 1992; Nelspruit: concession contract signed with Biwater in 1992; Dolphin Coast: concession contract signed with Saur in 1999)
- Mozambique (Aguas de Portugal signed in 2001 a 5-year affermage contract for 4 secondary cities: Beira, Quelimane, Nampula, Pemba. Studies about the next scheme are not finalized yet)

4. Small-Scale Providers Documented in Small Cities:

- Ghana
- Mauritania
- Uganda
- Zambia
- Tanzania
- Niger

5. Small-Scale Providers Documented in Periurban Areas:

- Chad
- Mali
- Kenya (Kibera, Kisumu)
- Mozambique
- Tanzania
- Nigeria
- Angola
- Benin
- Burkina Faso
- Côte d'Ivoire
- Ethiopia
- Ghana
- Guinea
- Mauritania
- Niger
- Nigeria
- RDC
- Senegal
- Somalia
- South Africa
- Sudan
- Uganda
- Zambia
- Zimbabwe

6. Community based Providers Documented in Rural Areas:

- Mali
- Burkina Faso
- Chad

A2. Typology of Private Sector Participation in Electricity Utilities in Africa (without IPP)

1. International operators in Big Cities (contract[54] in operation):

- Gabon (20-year concession contract signed with Veolia in 1999)
- Cameroon (20-year concession contract signed with AES in 2001)
- Côte d'Ivoire (15-year concession contract with more affermage elements signed in 1990 by Saur – EDF; renewed)
- Equatorial Guinea (society for production and distribution has mixed capital from the State and Infinsa)
- Togo (10-year concession contract for distribution and some production signed with HydroQuébec / Elyo in 2000; under stress)
- *Rwanda (5-year management contract signed in 2003 with Lahmeyer)*
- *Kenya (2-year management contract signed with Manitoba Hydro in 2005*)

2. International Operators in Big Cities (contract[2] terminated or not renewed)

- Senegal (concession contract signed with HydroQuébec / Elyo in 1999; terminated in 2000; further privatization was unsuccessful)
- Cape Verde (50-year concession contract signed with Aguas de Portugal; in crisis)

54. Operating and Maintenance or Management contracts in italic.

- Mali (Management contract in 1995 with Saur/EDF/Hydroquebec/CRC-Cogema terminated in 1997; Concession contract signed with Saur in 2000 for Bamako and 33 urban centers; terminated by Saur in 2005)
- *Chad (Veolia signed a 30-year management contract in 2000 which was supposed to evolve through a privatization process; terminated by Vivendi in 2004)*

3. PPP with Regional Private Sector:

- Uganda (Eskom has signed a concession contract for production in 2002)
- Uganda (Umeme, a private local company, is in charge of distribution since 2001)
- Zimbabwe (investment by Eskom)
- *Malawi (2.5-year management contract signed in 2001 with Eskom)*
- *Tanzania (2-year management contract with NetGroup Solutions from South Africa; extended until 2005)*
- *Lesotho (management contract signed by SAD-ELEC)*

4. Small-Scale Providers Documented in Periurban Areas or Small Cities:

- Côte d'Ivoire
- Senegal
- Somalia
- South Africa
- Tanzania
- Ethiopia
- Ghana
- Kenya
- Mali
- Mozambique
- Zimbabwe

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