Capture and Corruption in Public Utilities: The Cases of Water and Electricity in Sub-Saharan Africa

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Abstract: The paper focuses on private provision of public utilities services located in poor countries with a special attention to capture and corruption issues. It confronts Auriol and Picard (2002) optimal policy regarding private sector involvement in public utilities with empirical evidences on water and electricity in SSA. Consistently with the theory participation of private unregulated firms to the supply of services for the middle class and the poor is fairly common in SSA. By contrast service to the rich is achieved by public utilities. Theory 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 capture problem by the ruling elite. Since the ruling elite also designs and implements privatization programs, there is concern about the optimality of privatization programs. The paper analyzes the social cost of inefficient (corrupted) privatization. It is non-monotone in the opportunity cost of public fund. Because of the fiscal loss it represents, privatizing profit centres of public firms entails huge social costs in very poor countries. There are hence socially good privatizations and socially very bad ones. The good ones are hard to formalize in practice because they are not very lucrative for the private sector. By contrast the bad ones are easier to achieve. This explains that they certainly dominate.

Key words: public private partnership, privatization, capture, water, electricity, Sub-Saharan Africa.

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1. Introduction

Over the last 25 years low-income countries have drastically reduced their share of state ownership.[1] Governments have privatized public assets because of critical budgetary conditions, often as part of macroeconomic policy stabilization programs. Between 1990 and 1997 a substantial and unanticipated increase in private capital flows to the developing world then fuelled the hope that the private sector would be the next provider of investments in infrastructure and public utilities in poor countries. Ten years later the financial flows involved in the process are sobering.[2] Assessment of the privatization reforms is mitigated and varies widely depending on the assessor. Since they often led to improvements in the financial and operating performances of divested firms, specialists tend to think that they have been successful. This positive appraisal contrasts sharply with the popular view among consumers and taxpayers in developing countries, where there is a widespread perception that the reforms have hurt the poor, notably through increases in prices and unemployment, while benefiting the powerful and wealthy, notably through corruption. For instance in a 2001 survey of 17 Latin American countries 63% of participants disagreed or strongly disagreed with the statement: "The privatization of state companies has been beneficial" (The Economist July 28th-August 3rd 2001, p. 38). Similarly in Africa, reforms have been qualified as "re-colonization" due to the participation of foreign investors in many cases. Consumer dissatisfaction raises serious concern regarding the social benefits yielded by privatization in very poor countries. The paper aims to address this issue. It focuses on the welfare implication of private sector involvement in the provision of utilities services. It analyses the impact of corruption in privatization decisions regarding public utilities located in developing countries.

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1 Megginson and Netter (2001) estimated that between 1980 and 1996 public ownership went from 16% to 8% of GDP.

2 Since the Asian financial crisis, private investors, major commercial banks and international organizations have retreated from the sector. The withdrawal has been amplified by the weakening of the global infrastructure industry. Infrastructure finance to poor countries from international sources has declined by at least 50%. Yet at their 1997 peak, they were just 3.6% of total new international bond, loan, equity issuance (World Bank 2004). International private capital flows are not going to fill the huge investment gap in poor countries infrastructures

Anecdotal evidences suggest that the corruption problem in privatization programs is real. However it is hard to uncover and to quantify empirically. The paper relies on Auriol and Picard (2002) normative analysis to address the corruption issue and its welfare implication. It proceeds in two steps. Auriol and Picard (2002) study the relationship between the financial constraints of a country and its *optimal* industrial policy in infrastructure and utilities industries. It provides a benchmark against which governments' industrial policy can be assessed. The null hypothesis is that government follows the optimal industrial policy derived in the paper. This supposes that they are benevolent while managing their public utilities. In a first step, the hypothesis is tested by confronting the model theoretical predictions with the available empirical evidences on demand, prices, and industrial organization in water and electricity utilities in Sub-Saharan Africa. The advantage of focusing on utilities is that their services are priced and prices, contrary to corruption, are observable. The paper hence compares the optimal pricing scheme to the actual prices in water and electricity in several African countries. It concludes that capture is going on in public utilities.

To be more specific the theoretical predictions of Auriol and Picard (2002) vary with the profitability of the market segments. In unprofitable segments, Auriol and Picard (2002) predict that there is no service. As implied by the theory, the total level of service (private and public) is much lower in Sub-Saharan Africa than in advanced economies. In 2004 access to improve water sources was estimated to be around 56%.This level was sensibly the same than peer poor countries from South-Asia. In 2002 access to electricity was estimated at 24% of the total population by the International Energy Agency. This figure has to be compared with 48% in peer low income countries (IEA 2004). The absence of service in unprofitable market segments is consistent with Auriol and Picard (2002) results. That is, it is consistent with an efficient management of scarce public funds. However the fact that Sub-Saharan Africa has the lowest per capita consumption of electricity in the world signals a public management problem.

In low profitability market segments, the theory predicts that the service provision should be left to private providers. Consistently with the theory, participation of private firms to the supply of utilities services is fairly common in Africa. In peri-urban area, the private *informal* sector is bridging the gap between public services and the needs of the middle class and the poor. Local private entrepreneurs have understood all the profit they could make out of the fairly inelastic, uncompressible part of the demand. Water supply to the poor is in some African cities a textbook case of monopoly abuse. In electricity self sufficiency based on private generators and on

privately own and operated small electricity networks close the utilities gap at a high cost. One lesson from the analysis below is that in light of the financial constraint faced by African governments, it is a second best to let private providers serve the less profitable segments of the market. It is indeed better to have a privately own and operated utility service, even with monopoly distortion, than no service at all.

Finally, the theory predicts that profitable segments have to be served by public utility at high prices. The utilities' goal should be to extract rents out of the wealthy part of the demand to subsidize access to the middle class and the poor and/or for fiscal relief. Consistently with this result, public utilities services are limited to big cities and wealthy neighbourhoods. They focus on rich consumers so that in general only the fifth quintile (i.e., the 20% wealthiest consumers) benefit from a connection to public utilities. However piped water, and to a lesser extent electricity, are heavily subsidized. Subsidized prices for public utilities are in total contradiction with the optimal pricing scheme derived in the normative analysis. In other words, public utilities are not optimally managed. This either implies that the government is incompetent or not benevolent. Since the price mechanism has been captured by the ruling elite, we favour the latter conclusion. The social cost of the capture is high. Public utilities are losing money. They are unable to invest. The problem is particularly acute in electricity where access rate is half of the access rate in peer low income countries.[3]

The first part of the analysis establishes that the price setting mechanism has been captured by the ruling elite. We are hence obliged to reject the null hypothesis that African governments manage efficiently their public utilities. The problem is that the ruling elite is not only responsible for fixing prices in public utilities, it also designs and implements privatization programs. It is thus legitimate to be sceptical regarding the optimality of privatization programs. In a second step, the paper studies what happens if the government privatizes, possibly in exchange of bribes, a profitable firm's segment which, according to the normative analysis, should remain public. The paper derives analytically the social loss which depends on the opportunity cost of public funds. The loss formula is shown to be U shape and to diverge with the opportunity cost of the public funds. In other words, the social cost of corruption in privatization programs is much higher in poor

[3]The lack of power acts as a brake on the African economy because energy consumption is one of the most significant determinants of growth. For instance energy was the leading driver of growth in fast growing countries such as Brazil, Turkey and Korea (IEA 2004).

countries than in intermediate revenue ones. The intuition for this result is the following. Privatizing profit centers of public utilities represents a permanent loss of revenue for the government. In very poor countries the revenue of the government is very small (10% of GDP). The fiscal loss implies by the privatization immediately translates into a decrease of already dismally low spending levels in essential public goods, infrastructures, schooling or health care. The social cost of public finance contraction is hence huge. Since corruption risk is also higher in poor countries, the result helps to explain the unpopularity of the reforms. In practice inefficient privatizations do occur in poor countries and entails extremely high social cost.

The paper is organized as follows. Section 2 provides an overview of the standard micro-economics arguments for privatization. Section 3 presents Auriol and Picard (2002) macro-fiscal balancing results. Section 4 tests the theoretical implications of the model by contrasting them with the available empirical evidences on the provision of water and electricity in Africa. Section 5 presents the analysis of corruption in privatization. Section 6 concludes.

2. Privatization and Internal Efficiency of the Firm

Productive efficiency: Transfer of public ownership 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 literature on the subject as the *soft-budget constraint.* Interesting surveys are available in Kornai (2000), Kornai, Maskin and Roland (2002). Since less efficient firms are allowed to rely on the government for funding, they lack the financial discipline required for efficient management (Dewatripont and Maskin 1995, Schmidt 1996). Kornai (2001) provides evidence of the use of soft-budget constraints by state-owned enterprises (SOEs) in developing countries. 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 behaviour as they seek to protect or increase employment; in Shapiro and Willig (1990), governments are 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 available 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 firm performance. In three studies, looking at 204 privatizations in 41 countries, between 1/5 and 1/3 of privatized firms have registered very slight to no improvement, and even occasionally, worsening situations (Megginson and Netter 2001). However in all other cases reviewed privatization tend to improve firms' performance.

In developing countries, the gains from private sector involvement stem from better asset management and bills recovery. Andres, Foster and Guasch (2006), who studied the impact of privatization of electricity distribution in 116 cases in 10 Latin American countries, show that privatization generates improvements in labour productivity, efficiency and product/service quality. These good performances, which occurred for most of them in the transition period between the public and the private regime, have been achieved through a substantial employment reduction (i.e., by more than 40%). Similarly Manibog et al (2003) in their review of the World Bank experience with private participation in the power sector show that 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%. In Sub-Saharan Africa, where private operators have taken over retail supply, they have drastically reduced payment delays, theft, and unpaid bill. For instance unpaid bill were reduced from 30% to 12% for Compagnie Ivoirienne d'Electricité after the involvement of the private sector under a lease contract in 1990 (Manibog et al 2003). In water, a management contract was signed between Suez and Johannesburg Water in 2001 for the suburb of Soweto in South-Africa. As a result leakages and unaccounted-for-water losses decreased dramatically (Blanc and Ghesquières, 2006b). In Senegal, the network commercial rate (water paid over water produced) improved from 68% in 1996, year where a 10-year lease contract was signed with SAUR, to 80% in 2006. Gassner, Popov and Pushak (2007) evaluate the impact of private sector participation (PSP) on firm performance in electricity distribution and water and sanitation services with a panel of 302 utilities with PSP and 928 utilities without PSP in 71 developing and transition countries. They also find that PSP decreases employment, has a strong impact on the efficiency of utility operations, on bill collection ratios and on improvement in the quality of service.

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. In a perfectly competitive market where price equates marginal cost, it is true that consumers benefit from the efficiency gain generated by privatization. However, in increasing return to scale industries, moving from public to private ownership does not offer a solution to the lack of competitive pressure. In the absence of government intervention, firms with market power keep whatever costs' reduction they generate for themselves.[4] Empirical studies hence reveal that privatization results in lower prices and higher output in competitive industries, but not in oligopolistic ones (see Nellis 1999).

"*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*." (Birdsall and Nellis 2002)

Prices are often increased ahead of 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-BAD 2003). An unaccounted part of price increases stemmed from the termination of illegal connections (Birdsall and Nellis 2002, Estache et al 2002, OECD-BAD 2003). Similarly a recent study on the impact of privatization of electricity distribution in Latin America shows that privatization produced no changes for coverage and output once the authors control 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 tariffs decreased for industry and commerce but have risen for other customers (Manibog et ali 2003).

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[4]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 percent 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. Apparently 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 the profit of the shareholders (see Birdsall and Nellis 2002).

Regulation In increasing return to scale industries, such as water and electricity networks, traditional regulation literature recommends that a legal monopoly should be set to prevent wasteful duplication of investments. 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 ownership and private ownership under regulation of entry and price. The result is important because it illuminates that ownership is not the key to the allocative efficiency problem; in increasing return to scale industries regulation is the key. Empirical evidence supports this result. Using a panel data for 51 developing countries, over the period 1985 to 2000, 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*." The result is worrying because governments in developing countries have not been very successful in establishing regulatory institutions. They usually lack the human resources, the experience and the credibility necessary to control large corporations. 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). This problem is reinforced by the fact that, in practice, governments in SSA are not focused on consumer surplus.

3. Privatization and macro-fiscal balancing

Opportunity cost of public funds Government pursues multiple objectives, such as the production of public goods, the regulation of non competitive industries or the control of externalities, under a single budget constraint. Since in general the government budget constraint binds, the opportunity cost of the public funds, defined as the Lagrange multiplier associated with the constraint and denoted λ, is strictly positive. Contrary to the price mechanism, government intervention is not, and cannot be, anonymous; it depends on λ. 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, of commodities that generate externality such as health care

and education, or alternatively, increasing the level of taxes or debt. All these actions have a social cost, which must be traded off with 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. The opportunity cost of public funds measures this cost. It is higher when, everything else being equal, government revenue is lower.[5] 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 developing countries are unable to 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. In practice each euro that is transferred to a public firm costs $1+\lambda$ euros to society.

Auriol and Picard (2002) offer a theoretical analysis of the relationship between the financial constraints of a country, captured by the opportunity cost of public funds,. λ, and its optimal industrial policy. In the paper government assumes responsibility for a public firm's profit. It subsidizes it in case of loss and taxes it in case of benefit. In contrast managers and/or owners of privatized firms assume responsibility for the firm's cash flows. One benefit of privatization is that it reduces government subsidies to money loosing firms. However, privatization has a price. On the one hand, the government is unable to take advantage of positive cash flows in profitable firms. On the other hand, it abandons direct control of the firm's operations, especially prices, which has a cost to consumers. Privatization in developing countries is hence treated as the move from public ownership with regulation of entry and price 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 positive. When public finance matters, privatization without price control can dominate a benevolent regulation.

5The opportunity cost of public fund is different from the marginal cost of public fund (i.e., the dead weight loss of increasing marginally a specific tax). The MCF is a general equilibrium concept. It is relevant in the long run because it indicates the social cost/benefit of tax reform (Warlters &Auriol 2005).

Justifications for the assumptions above are provided in Auriol and Picard (2002). The paper considers both monopoly and duopoly structure. For the sake of simplicity we focus on the monopoly case. As explained in Section 4 it is more realistic in the case of Sub-Saharan Africa utilities because they operate below efficiency level of scale.

The model: On the production side, the cost function includes a sunk cost $K>0$. It is large so 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* on the parameter. It is assumed to be independently drawn from the support $[0,\overline{C}]$ according to a uniform distribution.[6] With a production level of *Q*, the firm has the following cost function: *C(Q)=K+cQ*. It maximizes the profit:

$$\Pi(Q)=P(Q)Q-cQ-K+t, \qquad (1)$$

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, the 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. In order to rule out corner solution in the sequel it is assumed that

A1 $\qquad a \geq 2\overline{c}$.

The gross consumer surplus, defined as the integral of the inverse demand function, is $S(Q) =aQ-0.5bQ^2$. Let λ be the opportunity cost of public funds. The government is utilitarian. It maximizes the sum of consumer surplus, *S(Q)-P(Q)Q,* plus producer surplus, $\Pi(Q)$, minus the social cost of transferring public funds to the firm, $(1+\lambda)t$. Government's objective function is therefore:

$$W = S(Q)-cQ-K \; - \lambda t. \qquad (2)$$

The transfer to the firm, *t*, can either be positive (i.e., a subsidy), or negative (i.e., a tax). For λ close to *0*, the government focuses on the net consumers' surplus (i.e., for $\lambda=0$ the government objective function is $W=S(Q)-cQ-K)$. For

[6] By contrast Auriol and Picard (2002) consider general distributions of marginal cost.

large λ, the government puts more weight on the transfer and less on consumers' surplus. In the limit it maximizes the revenue, *t*, it can extract from the firm. Under public ownership, denoted *RM*, the government's control rights on prices and quantities are associated with accountability on 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, in the private regime, denoted *PM*, the government imposes no control on prices and quantities, and it takes no responsibility for the firm's profits or losses. Transfers are hence ruled out between the government and the private firm.

Under private ownership the firm pays the sunk cost *K*, and chooses the *laissez-faire* monopoly quantity; $Q^{PM}(c) = (a-c)/(2b)$. Under public ownership the government pays the sunk cost *K*, and chooses the regulated monopoly quantity, which under the situation of asymmetric information is: $Q^{RM}(c) = (1+\lambda)/(1+2\lambda)\,(a-c_v)/b$, where $c_v = c(1+2\lambda)/(1+\lambda)$, is the total marginal cost of service provision. We deduce that $c_v \geq c$. It is larger than *c* because it includes the cost of production, *c*, plus the cost of information revelation, $c\lambda/(1+\lambda)$. Consistently with empirical evidences, in the model private firms are more efficient than public firms. It is straightforward to check that when $\lambda=0$, the government, which maximizes consumers' surplus, chooses $Q^{RM}(c)=Q^*(c)= (a-c)/b$. This is the first best quantity obtained when price P^{RM} equates marginal cost *c*. Symmetrically when λ goes to infinity the regulator maximizes the transfer it can extract from the firm. He chooses the quantity and price of the monopoly evaluated at the virtual cost, $\lim_{\lambda\to\infty} c_V = 2c$ so that $Q^{RM}(c)=Q^{PM}(2c)<Q^{PM}(c)$ and $P^{RM}(c)=P^{PM}(2c)>P^{PM}(c)$. Let *E* denote the expectation operator with respect to the uniform distribution on *c*. Let $V=E(a-c)^2/(4b)$. One can check that the expected profit of the private monopoly is: $EII^{PM}=V-K$. The *ex-ante* welfare level under private ownership is

$$EW^{PM} = 3/2V-K. \qquad (3)$$

Similarly let $V^{RM}(\lambda)=E(a-c_v)^2/(4b)$, be *V* evaluated at c_v instead of *c*. The *ex-ante* welfare level under public ownership is

$$EW^{RM}(\lambda) = (1+\lambda)\{(2+2\lambda)/(1+2\lambda)V^{RM}(\lambda)-K\}. \qquad (4)$$

The optimal choice between public and private ownership is obtained by comparing the two welfare functions (3) and (4). The optimal industrial policy corresponds to privatization if and only if $EW^{PM} > max\{0,EW^{RM}(\lambda)\}$.

Figure 1 summarizes the monopoly results. On the horizontal axis there is the opportunity cost of public funds λ. On the vertical axis there is the sunk cost *K*, so that higher cost corresponds to less profitable segment market. 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.

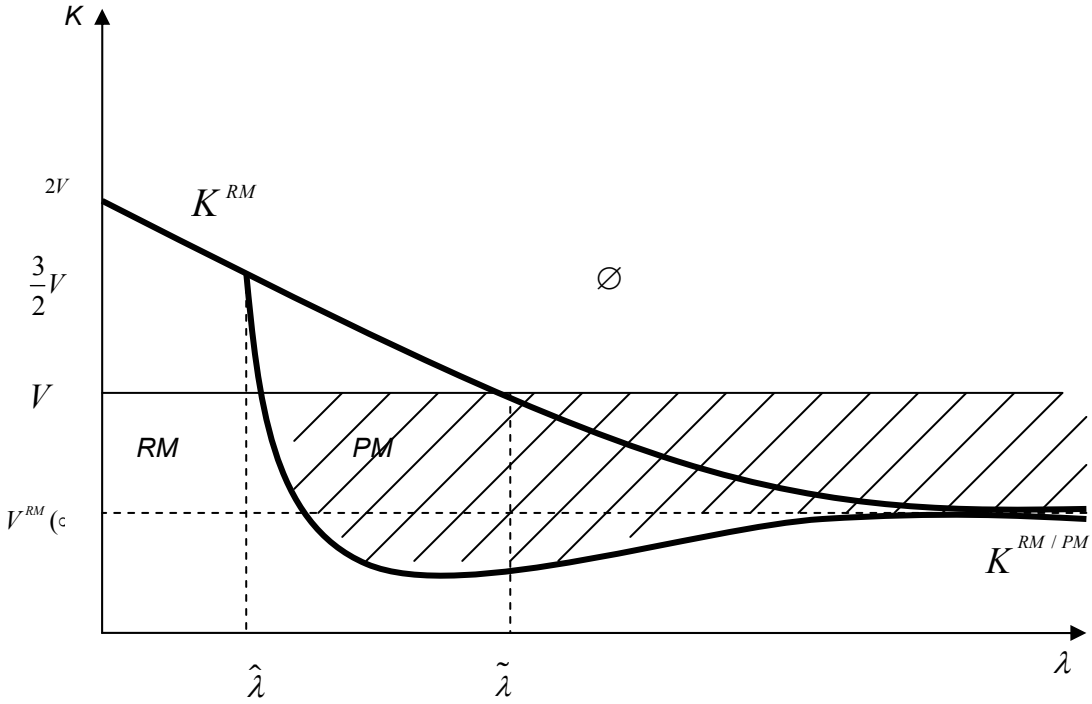

Figure 1: Optimal Industrial Policy for the Monopoly Case

4. Testing the Model Predictions: Water and Electricity in Sub-Saharan Africa

Auriol and Picard (2002) analysis is normative. The paper derives optimal industrial policy, which varies with the profitability of the market segments (i.e., with *K* on the vertical axis) and the opportunity cost of public funds (i.e., with λ on the horizontal axis). In the paper we want to test whether developing countries governments behave benevolently while managing their public utilities. We focus on water and electricity provision in Sub-Saharan Africa. The null hypothesis is that government in Sub-Saharan Africa follows the optimal industrial policy derived in the paper. There is very little data available on water and electricity in Sub-Saharan African. We thus test the null hypothesis by confronting the theoretical predictions of the paper with available empirical evidences on industrial organization, mainly from the World Bank and the French Development Agency (AFD) reports and publications. We complete the relevant information on industrial organization structure, with case studies and empirical studies on prices and on demand.

Return to scale in water and electricity Contrary to mobile telecommunication technology, electricity and pipe water industries still involve fixed connections between suppliers and customers. Water networks tend to constitute *local* natural monopoly because each city constitutes a distinct market. At the national level there are usually a multitude of local monopolies with different type of contracts and statuses. However at the international level, water industry is very concentrated. There are only four major companies that are operating in Sub-Saharan Africa: Thames Water, Vivendi, ONDEO, and SAUR, and two more at the worldwide level (Anglia Water and Yorkshire Water). Electricity networks tend to constitute *national* (or even regional) natural monopoly because they are more efficient when operated at larger scale.[7] Sub-Saharan Africa has the lowest electricity and water demand per capita in the world. Both water and power industries are operating below efficient level of 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 in the order

[7] In the European electricity market, the 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-third of the European markets is now in the hands of eight large companies, (Jamasb and Pollitt 2005). 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 at 50%.

of 24%. This result militates for more concentration in the electricity industry, and against reforms aimed at unbundling existing African utilities. In practice unbundling has only been experimented in Uganda and Kenya, without success. In Kenya, electricity production and distribution have been separated by the Electicity Act in 1997. Since the performance of Kenya Power and Lighting Company (KPLC), which is in charge of the power distribution, has been very poor, notably in access rate (only 15% of the population) and in financial performance, the Energy Sector Recovery Project in Kenya (2004) is not contemplating introducing competition in the distribution sector anymore. World Bank reforms to unbundle existing public electric utilities in Europe and Central Asia (ECA), which share many features with African utilities, have also been very unsuccessful. Re-concentration into larger entities has been necessary in several cases (Manibog et ali 2003). Similarly water utilities are operating below efficient level of scale. Tynan and Kingdom (2005) study 270 world water and sanitation providers, including 83 African ones. In the African cases they found very significant scales efficiency effects. By doubling population served it only increases operation and maintenance costs by 61%. Similarly Estache and Kouassi (2002) study 21 African utilities in 1995-1997. They found that the average efficiency level, which is correlated with the utility size, is of 54%. These results militate for more concentration and integration. Water utilities have to expand their services by connecting more households and firms in area where they are already operating. Electricity utilities need also to grow and to absorb private sub-networks. This integration strategy will increase their productivity and decrease their costs. Based on these results we rule out duopolistic structure and focus on monopoly.

Theoretical results Figure 1 shows that, depending on $\hat{\lambda}$ and on $\tilde{\lambda}$, optimal industrial policy might be different in rich and in poor countries. The privatization of natural monopoly with price liberalization dominates a benevolent regulation under public ownership for intermediate values of λ (e.g., for $\lambda > \hat{\lambda}, K^{RM} > K^{RM/PM}$). The relevance of the privatization result depends on what "intermediate" values means. If they are very high, in practice privatisation is never optimal. In order to test the theory we need to assess which values $\hat{\lambda}$ and $\tilde{\lambda}$ take under the model assumptions. It turns out that the two threshold values depend solely on the ratio $\overline{c}/a$. This ratio measures the *ex-ante* technological uncertainty. Indeed with a uniform distribution uncertainty rises with $\overline{c}$ (i.e., $\sigma^2 = \overline{c}^{\,2}/12$). In Sub-Saharan Africa cost/demand uncertainty are exceptionally high, as shown by all international risk rating agencies. To take into account the SSA specific context we need to consider large values of $\overline{c}$. However we are limited by the model's

assumptions. In what follow we consider the lower bound of A1. The next result is shown in Appendix A.[8]

Proposition 1: Let $\overline{c}$ *=a/2, then* $\hat{\lambda}$ *=0.35 and* $\tilde{\lambda}$ *=1.*

. 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. The heavily indebted poor countries (HIPC) initiative currently identifies 40 countries, most of them in Sub-Saharan Africa.[9] Governments of countries classified HIPC have an extremely high opportunity cost of public funds. In other words, under the model assumptions, most Sub-Saharan countries, especially HIPC, are on the right side of $\tilde{\lambda}$ in Figure 1. A likely exception is South Africa, which shares many features of advanced economies. The next result is shown in Appendix A.

Proposition 2: Let $\lambda \geq \tilde{\lambda}$. *Depending on market segments profitability three cases hold:*

(i) K >V: there is no service (nor private, or public).

(ii) $K^{RM/PM}(\lambda) < K \leq V$*: service is private and price is unregulated* $P^{PM}(c)$.

(iii) $K \leq K^{RM/PM}(\lambda)$*: service is public and the regulated price,* $P^{RM}(c)$*, increases with* λ *so that* $EP^{RM}(c) > EP^{PM}(c)$ *for* $\lambda > a/\overline{c} - 0.5$.

The paper predictions which can be tested with stylized facts concern the ownership structure (public or private), the regulation of price (presence or absence) and the government transfer schemes (subsidies or taxes). Predictions vary with market segment profitability (higher value of *K* corresponds to less profitable segment market). We thus study how different income groups are served by public utilities and by private providers in Sub-Saharan Africa.

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[8] Auriol and Picard (2002) do not compute $\tilde{\lambda}$. Yet they show that $\hat{\lambda}$ varies between 0.35 and 1.14 when $\overline{c}$ varies between *a/2* and *a/10.*

[9] See Official HIPC website.

Model predictions:

Unprofitable segment: The unprofitable part of the market is depicted on the upper part of figure 1. For K above V the private firm makes a loss. 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 line V. The no production area, which is labelled ϕ, is above the curve K^{RM} and the profitability line V.[10] We deduce from Proposition 1and 2:

Prediction (i): In poor Sub-Saharan African countries there is no service in unprofitable market segments (nor private, or public).

The level of access rate of water and electricity is lower in SSA than in richer countries. Indeed electrification or connection to piped water in remote, low density area is achieved through subsidies (e.g., cross-subsidies in some OECD countries). In poor countries the opportunity cost of the subsidies is higher than the social return of the investment. Since the private sector cannot break even, there is no service in poor and low density areas. People rely on self collected wood and water for their basic needs of water and energy. A study by the ABD on 13 Sub-Saharan countries hence shows that 63% of household energy consumption was wood in 1994.[11] This figure, which is based on surveys, is a rough estimate. The World Bank WDI 2007 statistical database reports that combustible renewable and waste was 56% of total energy consumption in SSA in 2004 (based on a sample of countries). In water the situation is somewhat comparable. Indeed in 2004 it was estimated that 44% of African did not have access to improve water source.[12] Among the 56% of African who had access to "safe" water, 40%

[10] When $\hat{\lambda} < \lambda < \tilde{\lambda}$ for the area which is comprised between the curve $K^{RM/PM}$ and K^{RM}, the 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 international organizations might find useful in relatively wealthy countries to subsidize private firms to serve this unprofitable segment.

[11] See http://www.helio-international.org/Helio/anglais/reports/africa.html

[12] Access to improve water sources 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. Improved water source refers to a source that is likely to provide "safe" drinking water, such as a household connection, a borehole, public standpipe, protected dug well, protected spring, rainwater collection. It does not include unprotected well, unprotected spring, vendor provided water, bottled water, tanker truck water. For more on water supply and sanitation see WHO/UNICEF at http://www.wssinfo.org/en/welcome.html and http://www.wssinfo.org/en/233_wat_africaS.html.

rely on a borehole, public standpipe, protected dug well, protected spring, or rainwater collection. In other words, 84% of African did not have connection to piped water network in 2004. For the great majority of African households, wood and its derivatives constitute the only energy source, and self collected water the only water source. Children walk hours to assist their parents in these chores. For instance a study conducted in 2002-2003 in rural Guinea reveals that children between age 6 and 14 spend 4 hours per week on average collecting wood and water. Girls spend more time collecting water and boys spend more time collecting wood (Bardasi and Wodon 2006).

Low profitability segment: When *K* varies between $V^{RM}(\infty)$ (i.e., the limit 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 value public ownership dominates privatization, while the reverse is true of high opportunity cost. Governments with abundant fiscal 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 titled towards transfers. Subsidizing infrastructure with low social return is costly. Privatization is an appealing alternative to public provision. Consider the limit case where the government cannot finance an infrastructure, for instance small water network or generation facility. If a private firm is eager to do it in exchange for the freedom to charge monopoly pricing it is optimal to let the firm do so. Indeed, it is better to have a privately owned and operated infrastructure, even with the monopoly distortion, than no infrastructure at all. This is the same logic which is at work in patent allocation. By continuity the result still holds when the government is able to finance the infrastructure.

Prediction (ii): In poor Sub-Saharan African countries service to low profitability market segments is left to the private sector and is unregulated.

Because SSA countries have large opportunity costs of public funds, they implement industrial policies that strongly differ from those favoured in developed economies. There is a public good aspect and externalities associated to sunk cost investment such as infrastructure. As recommended by standard economic theory, wealthy nations subsidize the construction of most infrastructures and let people use them at marginal cost. With a low opportunity cost of public funds this policy maximizes welfare. By contrast

countries plagued by financial problems cannot follow this strategy. Private provision of utilities services is hence fairly common in SSA.

Formal privatizations and public and private partnerships (PPP) between governments and international firms, have attracted a lot of attention and mobilised a lot of resources from international organizations.[13] Not only the reforms have been expensive to design and implement, but they also were often unsuccessful. A striking example is EDM in Mali where a management and a concession contract have successively been signed and terminated over 10 years 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*'. In Sub-Saharan Africa the preferred arrangements for formal private participation in water industry have been concession and lease contracts (PPP with risk sharing for rehabilitation and extension of an existing infrastructure). In electricity Estache and Wodon (2006) report that over the period 1990-2003 greenfield contracts (Build Operate and Transfer) have been the most popular type of PPPs. However Appendix B, which reviews official PPP, shows that there are not many of them. Formal contracts are only the tip of the iceberg. There are thousands of small scale providers of water and electricity services operating informally. They did not receive much attention from aid agencies and academia. Yet, they are filling the service gap in low profitability segments.

In the water sector returns to scale are lower than in electricity. Water networks constitute natural *local* monopoly. Since it is easier to produce a service at small scale, small-scale operators play a very important role in peri-urban areas of capitals cities. A recent survey of 400 documents (articles, reports, case studies) by Kariuki and Schwartz (2005) 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 hence 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. Case studies confirm the

[13]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).

survey. For instance in Maputo 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, in the richest quintiles even though they do not receive any subsidy for their operation.[14] As predicted by the theory the private providers are bridging the public service gap at a high cost. They are unregulated and do not receive any subsidy so that the price of their service is much higher than the public utilities price.[15] For instance a study in the city of Niamey shows that the average price paid for water by the poorest 20% households is roughly 2.6 times higher than the price paid by the richest 20% (Bardasi and Wodon 2006). Similarly a case study in the city of N'Djamena shows that the corporation of water caters is well organized. It behaves as a cartel and applies the 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). Kariuki and Schwartz (2005) show 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.

In electricity, 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). However many large consumers (i.e., firms) overcome the problem posed by the lack of power, by owning or sharing a generator. *Investment Climate Assessments*, which draw upon the results of enterprise surveys to prioritize constraints to business, show that 40% of the establishments surveyed in the region own or share a generator.[16] This extreme form of privatization, which yields a very high cost per Kwh, occurs because the power penury is acute. On average in the sample, it takes 52.6 days to obtain an electrical connection; there are 50.5 days of electrical outages generating losses evaluated at 9% of sales. Once they are self-sufficient, firms tend to focus on others problems than electricity. For instance in Kenya 71% of the firms surveyed own or share a generator. Electricity is thus ranked 9 (one of the "best" score in the sample) among the 19 possible constraints. These results are far from exhaustive. The number of surveyed

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[14] AFD-Hydroconseil-SEURECA (2005).

[15] Dardenne (2006) objects that competition among water tankers and carters can in some cases keep the profit margin low (e.g., US$ 2-3 per day for carters in Nouakchott, Bamako or Ouagadougou). Nevertheless, prices are still higher for poor customers than rich ones.

[16] Surveyed countries are Benin, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mali, Mauritius, Senegal, South Africa, Tanzania, Uganda, Zambia http://www.enterprisesurveys.org/icas.aspx

establishments in each 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 Sub-Saharan economy are not in the surveys. Finally the study does not consider domestic consumers. They often rely on small-scale providers for basic lighting service and/or for batteries.

Until now, economists and international organizations have overlooked the private informal firms in water and electricity sectors. For the future it would be very 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,[17] while in exchange controlling their prices. A good example can be found in small cities of Mauritania, where local operators have signed 3-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.[18]

Profitable segment: When the public utility is profitable the optimal industrial policy is non-monotone in the opportunity cost of public funds. 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. The fiscal argument works for every country in the world. Governments of advanced economies care for the revenues generated by their utilities.[19] The difference between them lies in

[17]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 constraint.

[18]See AFD-Hydroconseil (2002). See also AFD-BPD- Hydroconseil (2006).

[19]In the USA 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 tax's opponents 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 USD 5.185 billions in fiscal year 1999 (reported in *budget of the United States Government, fiscal year 2000*).

the weight that this argument assumes. As they are not able to tax as efficiently as advanced economies, developing countries need the additional revenues more badly.

Prediction (iii): In poor Sub-Saharan African countries public utilities serve profitable market segments only. Regulated prices are set high to extract rents out of the wealthy customers. On average they are larger than private monopoly prices.

In 2002 access to electricity was estimated at 24% of the total population by the International Energy Agency. This figure has to be compared with 48% in comparable low income countries (IEA 2004). On a sample of 48 African countries, Estache and Goicoechea (2005) find average access rate to be as low as 15% of the total population, against 31% in other low income countries. The situation is worse in rural areas where they estimate average access rate at 8%; the IEA estimates it at 5%. The discrepancy in the estimates is not surprising. It reflects the deficit of hard information available on the region. The IEA, which collect information on energy worldwide is usually fairly exhaustive, do not provide any information on many SSA countries.[20] Whatever the exact level, satellite pictures at night clearly show that, at the exception of South Africa and of some capital cities, the continent is devoid of electric power.[21] Similarly in 2004 the percentage of household with a connection to piped water network was estimated at 16% in SSA. In sanitation the percentage of household with an access to sanitation network was estimated around 8% by the WHO/UNICEF monitoring program.[22] Consistently with *(iii)* connected people to public utilities are the rich. A recent study by Diallo and Wodon (2005) of 26 African countries shows that the connection rate to piped water is nil in the first (poorest) quintile. In the second quintile it is nil in 23 countries. In the third quintile, it is still nil in 18 countries, and below 3% in three additional countries; it is 26% in Cote d'Ivoire, 17% in Comores, 7% in Kenya, 9% in Namibia, and 16% in South Africa. In the fourth quintile, connection rate are still below 5% in 19 countries; the access rate in the 7 remaining countries is above 20%. Finally one has to move to the fifth quintile to find positive access rate in all of the countries. In other words, access rate to piped water is almost 0% in the first three quintile of income group in 21 countries. This figure is consistent with

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20 Namely Burkina Faso, Burundi, Central African Republic, Chad, Equatorial Guinea, Guinea, Guinea Bissau, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Niger, Rwanda, Sierra Leone, Somalia, Swaziland, Uganda http://www.iea.org/Textbase/country/11_country.asp

21 See http://www.junglephotos.com/africa/afspace/continent/africaday.shtml

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

the WHO/UNICEF statistics which put at 16% the share of African with an access to piped water.

Based on the normative analysis, the biggest concern with African public utilities is their commercial and pricing policy. In line with the theory, they focus on the wealthy segment of the demand, but contrary to the paper recommendation they do not make a profit out of it. According to the model prediction they should charge a price above the private monopoly price. Yet public utilities services are subsidized which is in total contradiction with the normative results. It signals a capture problem of the public utilities by the local elite. The under pricing problem is striking in water. Empirical studies show that there is a strict negative relationship between income and the price of water m^3 in SSA. For instance a study in the city of Niamey shows that households pay on average in the first quintile FCFA 645/m3, in the second FCFA 541/m3, in the third FCFA 509/m3, in the fourth FCFA 422/m3, and in the fifth FCFA 249/m3. Differences are even larger if shares of water budget in the household budget are compared (Bardasi and Wodon 2006). Similarly the survey of different papers and cases studies on small-scale private service providers by Kariuki and Schwartz (2005) 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. It has been estimated that water utility need to charge at least a price of US$1 per cubic meter in developing countries to cover operating, maintenance and most investment needs (Foster and Yepes 2006). The financial gap is closed with scarce public funds and with the suppression of investment in maintenance and in network extension. With the poor paying up to 10 time the price of the rich, doubling the price of piped water in Sub-Saharan Africa and collecting the bills is not only a matter of efficiency, it is also a matter of justice. Such increase in tariff is possible because it has been implemented in many other developing countries. For instance in Uruguay residential water tariffs were raised in nominal term at an average annual rate of 25% (15% in real term) over the period 1997-2003 (Foster and Yepes 2006). Tariff increase should be easier in SSA because only the rich are connected.

In electricity the pricing situation is somewhat better. Comparing the two industries, Foster and Yepes (2006) estimate that low income countries are 69% to achieve some degree of cost recovery in electricity, while they are 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. It remains that in most African countries tariffs are too low to fully recover the costs. To be able to invest more the

public utilities tariffs have to be raised. For instance in Rwanda the per kwh price has been multiplied by two 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 maximize profit and to shield the poorest consumers from the burden of the necessary price rises. Contrary to water, there are some evidence of a positive relationship between consumption of electric power and wealth. Sophisticated pricing policies obviously require metering of consumption. Finally there is no point in raising tariffs if commercial performances are not improved first. The problem of bills collection is massive in sub-Saharan Africa. For instance in Bangui (RCA), SODECA in water and ENERCA in electricity manage to charge only 30% of the amounts they produce. If this rate was improved to a reasonable 70%, more than 1 Million euros in water and 5 Million euros in electricity would be spared annually. Similarly in Kinshasa (RDC) the collection rate of REGIDESO (water) is 35% and SNEL (electricity) is 30%. It is hard to assess the impact of decades of inadequate pricing policy. However public utilities which are making losses cannot invest so that in the long run, access is too low. This is especially true in electricity. Not only did SSA have the lowest per capita consumption of electricity in the world, but international comparisons reveal that access rate in SSA is half of the access rate in peer low income countries.

5. Inefficient Privatization

The preceding analysis shows that public utilities are not optimally managed in SSA. Prices are too low. Moreover the government and the elite do not pay their bills. This situation clearly suggests a capture problem: the powerful and wealthy subsidize their consumption of utilities services with scarce public funds. We are obliged to reject the null hypothesis that African governments are managing optimally their public utilities. The problem is that the same ruling elite is responsible for designing and implementing privatization programs. There is thus some concern about the optimality of privatization programs designed by corrupt/inefficient people. Indeed much more profit can be made by selling out public utilities assets than by simply capturing them. This point is emphasized by Stiglitz (2002)

"*…in many countries today privatization is jokingly referred to as 'briberisation'. If a government is corrupt, there is little evidence that privatization will solve the problem. After all, the same corrupt government*

that mismanaged the firm will also handle the privatization. In country after country, government officials have realised that privatization meant that they no longer needed to be limited to annual profit skimming. By selling a government enterprise at below market price, they could get a significant chunk of the asset value for themselves rather than leaving it for subsequent office holders." Stiglitz (2002)

There are anecdotal evidences documenting corruption in privatization programs in many developing countries. This is the case in Latin America.[23] For instance Boehm and Polanco (2003) report corruption in water utilities in Argentina and in Brazil. This is also the case in transition countries, as documented by Turnovec (1999) for the Czech Republic, and in Asia. Boehm and Polanco (2003) report corruption in privatization of water utilities in Manila, Hall (1999) reports corruption in the allocation to private firms of Jakarta water concessions and in Indonesia electricity contracts. Finally this is also true in SSA. For instance Société Tchadienne d'Eau et d'Electricité signed in 2000 with Vivendi a management contract that came to an abrupt end in 2004 after 4 years of suspicious practices by many actors, funds wasted by donors and rumours of corruption about the Sedigui oil project. In Uganda, revelations about corruption in privatization brought the resignation of the privatization minister and the parliament in late 1998 chose to suspend the entire privatization process until it had completed an inquiry.[24] Finally inefficient privatizations might occur because of incompetence. Indeed privatizations have often been imposed as part of structural adjustment programs. Governments were put under pressure by international organizations to downsize the public sector. In the haste to comply, some bad deals might have been cut.[25]

Corruption and/or incompetence in privatization yield costs both for tax-payers and for consumers. In what follows we assess the social loss generated by inefficient privatization. It is not possible to assess it by classical statistical techniques. There is no data on the extent of the problem. Moreover it is hard to benchmark performance. Nobody knows what would have been the social welfare if the most efficient industrial structure had been adopted. We rely on theoretical analysis to uncover this

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[23] For a theoretical analysis see Martimort and Straub (2007) and for a test Bonnet et al (2007).

[24] See http://www.un.org/ecosocdev/geninfo/afrec/subjindx/141priv.htm

[25] Henisz and Zelner (2004) analyze the coercive role played by donors and international lending institutions in private electricity projects. They focus on the resistance to the multilateral influence on reform and its impact on the probability of contract term renegotiation/ contestation.

out of equilibrium information. We study what happens if the government privatizes a profitable firm's segment which, according to the normative analysis, should remain public. In the model inefficient privatization occurs when $K \leq K^{RM/PM}(\lambda)$ in Figure 1. Indeed in this case public ownership dominates private ownership. The welfare loss generated by inefficient privatization is denoted $L(\lambda)=EW^{RM}(\lambda)-EW^{PM}$. It depends on the opportunity cost of public funds. Let $V^{RM}(\infty) = \mathrm{E}[(a-2c)^2]/(4b)$. The next result is shown in Appendix C.

Proposition 3: Let $K \leq K^{RM/PM}(\lambda)$ *and let* $\lambda \geq \hat{\lambda}$. *The loss function of privatization is*

$$L(\lambda) = -\frac{\lambda}{1+2\lambda}\frac{a^2}{4b} + \lambda\left[V^{RM}(\infty) - K\right] + \frac{5}{4}V - \lambda K \qquad (5)$$

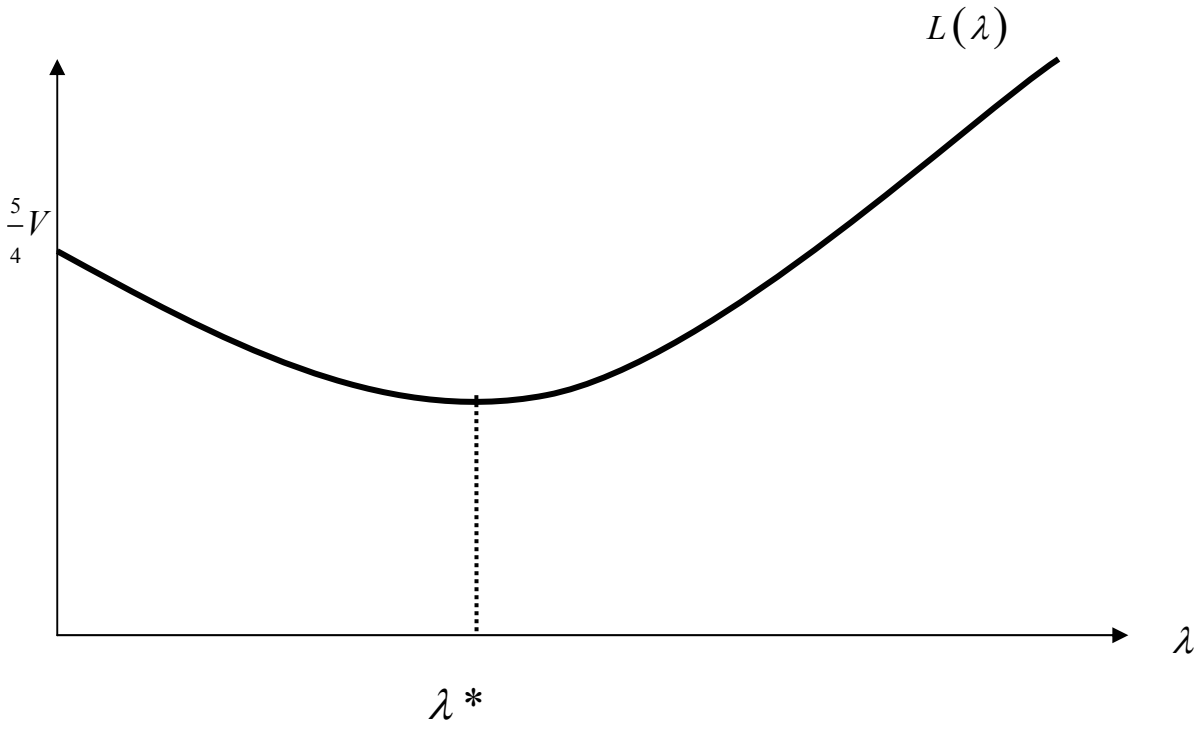

Figure 2: Loss Function of Inefficient Privatization

Figure 2 illustrates Proposition 3. Appendix C shows that $L(\lambda)$ is strictly convex. It first decreases, reaches a minimum at λ^*, and then increases. The appendix shows that for $\overline{c} = a/2$, λ^* varies between 0.37 and 1 when K varies between 0 and $a^2/(18b)$. In other words under the model assumptions, SSA countries tend to be on the right side of λ^*.

The benefit to a private firm of inefficient privatization is fixed: $EII^{PM}=V-K$. By contrast the social loss depends on the opportunity cost of public funds and is unbounded. It diverges with λ. Loosing public utilities profit centres is socially extremely costly in very poor countries. In practice the loss is mitigated because one does not move from optimal regulation to laissez-faire monopoly. As we previously shown many inefficiencies occur in the management of public utilities. It remains that a corrupted government will choose to privatize the profit centres and the best performing public firms. To maximize the bribes it will do so in exchange of monopoly power.

It is hard to find empirical evidences to assess the result of Proposition 3. Nevertheless inefficient privatization yields a fiscal cost. Private investors target profit centres so that public utilities restructuring, aimed at encouraging private participation in developing countries, has resulted in cream-skimming. The private firms took over large urban areas, while abandoning unprofitable rural segments. Consistently with the theory, the result has been an increase in the fiscal costs of the sector when the profit centres used to finance cross-subsidies were handed out to the private sector (Estache and Wodon 2006). There are also significant evidences of higher net fiscal cost associated with the privatization of public utilities profit centre in Latin America (Trujillo et ali 2003). Another result is to exacerbate regional disparities when territorial cross-subsidies are abandoned.[26]

The second piece of evidence concerns the nature and extent of private investment. According to the theory tight budget constraints imply that privatization may be optimal for low profitability segments of the industry (case *(ii)* in Proposition 2). However for profitable segments (i.e., for $K \leq K^{RM/PM}(\lambda)$) the combination of allocative inefficiency and critical budgetary conditions favour public ownership. Yet if the government is corrupted or incompetent it carries out socially inefficient privatization, possibly in exchange of a bribe. This result implies that virtuous governments should find difficult to attract investors simply because they sell

[26] In Uganda, about 40 water services are operated by local private operators who recover their costs from user charges without any cross subsidies between centers. By contrast, in Côte d'Ivoire, 600 semi urban centers are operated with a cross subsidy scheme at the national level.

the least profitable segments of their public utilities. By contrast corrupted government should attract more easily private investors because they focus on selling public firms profit centres. Consistently with this result, Ghosh Banerjee, Oetzel and Ranganathan (2006) find empirically that more corrupt countries attract more private infrastructure participation than less corrupt countries. According to their computation one unit increase in the index measuring corruption implies 31% more infrastructure investment.[27]

The final piece of evidence concerns the unpopularity of privatization. In developing countries there is a widespread perception that the reforms have hurt the poor, notably through increases in prices and unemployment, while benefiting the powerful and wealthy. For example, the poling firm Latinobarometro, which conducts each year surveys among 19,000 people in 18 Latin American countries, revealed that 80 % of respondents viewed privatization negatively in 2003. Similarly surveys from Sub-Saharan Africa, post-communist transition states and South Asia show a strong popular opposition to privatization policies (Kikeri and Kolo 2005). Privatization reforms have even been qualified, including by Gabonese Interior Minister Louis Gaston Mayila, as "economic recolonization", due to the participation of foreign firms in many cases. The progress of democracy implies that in a few countries government have been overturned by the unpopularity of the reforms, either through election or military coup. This negative appraisal contrasts sharply with the positive view among some specialists (see Section 2). Since they think that the reforms have been successful, they conclude that they have not been understood by the people. They are unhappy with privatization because of irrational belief and ideology. However African people are not against private providers. As explained earlier, utilities services are more market oriented in SSA than in other regions in the world. The small, informal providers, which are closing the utilities service gap at a high cost, benefit from a positive image in the population. They are close to the people and responsive to their needs (notably in payment scheme). Consistently with *(ii)* they offer a valuable service that would not exist otherwise. This is well understood by Africans. By contrast the direct economic benefits of public utilities privatization have been minimal. Over

27 The partial sale of SEEG, the public electricity and water utility of Gabon, to local firms (19%) and Gabonese people (15%) is an example of how a success story might be transformed into a failure. Because the public firm had a good reputation, the demand for the shares has been so high that the government has been obliged to ration their allocation (AFD 2006). The problem is that President Omar Bongo cumulates the role of regulator and shareholders (he owns 3.5% of SEEG). Some analysts are concerned by the excessive amount of dividends paid to shareholders. They are draining the firm profits, which is unable to invest anymore.

the period 1992-2003, the continent managed to attract only 4% of total international investment in infrastructure (World Bank 2004).[28] Private firms, which were expecting rate of return of 16% or more, have generally been disappointed by the profits they could secure in developing countries. Discouraged by the unpopularity of their action and the changes in policy that unfolds (see Harris 2003), many of them have retreated from the utility services. This has for instance been the case for Véolia in Guinea, for Saur in Mali, for Hydro-Québec and Elyo in Sénégal, and for Biwater in Tanzania. The secrecy with which many sales were concluded fuelled the public perception that privatization benefited foreign investors or local entrepreneurs with political connections.

7. Conclusion

The paper focuses on private provision of public utilities services located in poor countries with a special attention to capture and corruption issues. It confronts Auriol and Picard (2002) optimal policy regarding private sector involvement in public utilities with empirical evidences on water and electricity in SSA. It helps to distinguish 3 cases. First, for the great majority of African households, wood and its derivatives constitute the only energy source, and carried water the only water source. This is not inconsistent with an efficient management of public funds because the social cost of subsidizing public services in poor remote area is much larger than the social benefit. Financing essential public goods, basic health care and education, is more important than building low return infrastructures.[29] Second, services provision is more market oriented in SSA than in OECD countries. Indeed the middle class and the poor generally are not connected to public utility so that they do not get any 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 most African governments, it is a second best to let them serve freely the less profitable segments of the market. In other words, *Laissez-faire* in low profitability segments is not inconsistent with an efficient management of scarce public funds. It is then wrong to stigmatize the small private providers because their

[28]Most international financing went to East Asia (44%) before the East Asia crisis and after the crisis to Latin America, Europe and Central Asia.

[29]It is worth noting that advanced economies do not provide access to tap water and electricity to all. If people in isolated locations want services they either finance the connecting cost, or build their own facilities. Otherwise they have to move to more densely populated area.

prices are high. They offer an important service that the government is unable to provide. The paper contributes to illuminate the positive role they play in this respect. They are de facto fairly popular among their customers. By contrast public utilities serve only the rich, but represent a fiscal burden to all. It is a matter of justice and efficiency to increase public utilities revenues to subsidize investment and fiscal relief. The paper hence shows that prices are set to favour the powerful and wealthy rather than taxing them. In other words, the public utilities are captured by the ruling elite. Privatizations occurring in countries where public utilities are so poorly managed are very unlikely to be efficient. Indeed public utilities reforms such as privatization are not trivial to set. They must take into account the fiscal constraint faced by developing countries. Privatizing profit centres or profitable public firms in exchange of bribes entails huge social costs in very poor countries. The analysis hence illuminates that there are socially good privatizations and that there are bad ones. The good ones are hard to formalize in practice because they are not very lucrative for the private sector. By contrast the bad ones, which presumably dominate, are easier to achieve. They are also very unpopular.

APPENDIX A: Proof of Proposition 1 and 2

Proof of Proposition 1*:* Auriol and Picard show that when $\underline{c}=0$ and $\overline{c}=a/2$ then $\hat{\lambda}=0.35$.[30] To complete the proof of Proposition 1 we need to show that $\tilde{\lambda}=1$.

$$\tilde{\lambda} \quad st \quad K^{RM}(\lambda)=V$$

$$\Leftrightarrow \qquad 2\frac{1+\lambda}{1+2\lambda}V^{RM}(\lambda)=V \qquad (i)$$

Substituting $V=\frac{E(a-c)^2}{4b}$ and $V^{RM}(\lambda)+\frac{E\left(a-\frac{1+2\lambda}{1+\lambda}C\right)^2}{4b}$ into *(i)* yields after some straightforward computations:

$$0=2\lambda^2 E\left(C^2\right)-4\lambda(1+\lambda)E\left((a-C)C\right)+(1+\lambda)E(a-C)^2$$

$$\Leftrightarrow$$

$$0=2\lambda^2\frac{\overline{C}}{a}\left(\frac{\overline{C}}{a}-1\right)+\lambda\left(\left(\frac{\overline{C}}{a}\right)^2\frac{3}{5}-3\frac{\overline{C}}{a}+1\right)+1+\frac{1}{3}\left(\frac{\overline{C}}{a}\right)^2-\frac{\overline{C}}{a} \qquad (ii)$$

Let $\frac{\overline{C}}{a}=\frac{1}{2}$. Equation *(ii)* is equivalent to: $-6\lambda^2-\lambda+7=0$

This second degree equation admits two roots: $\lambda^-=-\frac{12}{14}$ and $\lambda^+=1$

Proof of Proposition 2:

Part *(i):* $K>V$ implies that private production is not possible, and $\lambda>\tilde{\lambda}$ implies that $K^{RM}(\lambda)<V$ because $K^{RM}(\lambda)$ is decreasing in λ (see Auriol and Picard 2002) and $\tilde{\lambda}$ is such that $K^{RM}(\lambda)=V$, so that public production is suboptimal.

Part *(ii):* $K\leq V$ implies that private production is possible $K^{RM/PM}(\lambda)<K$ implies that private production is strictly better than public production.

Part *(iii):* $K\leq K^{RM/PM}(\lambda)$ implies that public production is better than private production. The prices yield:

[30] Auriol and Picard (2002) rely on simulation to compute the threshold value $\hat{\lambda}$. Depending on the technological uncertainty (e.g., on $\overline{c}$ varying between 0 and a/2), it lies in [0.35, 1.14].

$$P^{PM}(C) = a - b\,Q^{PM}(C) = \frac{a+C}{2} \text{ and } P^{RM}(C) = a - bQ^{RM}(C) = \frac{\lambda}{1+2\lambda}a + C$$

We deduce that

$$EP^{PM}(C) = \frac{a+EC}{2} = \frac{a+\overline{C}/2}{2} \quad and \quad EP^{RM}(C) = \frac{\lambda}{1+2\lambda}a + EC = \frac{\lambda}{1+2\lambda}a + \frac{\overline{C}}{2}.$$

$$EP^{RM}(C) \geq EP^{RM}(C) \Leftrightarrow \lambda \geq \frac{a}{\overline{C}} - \frac{1}{2}$$

APPENDIX B: Public Private Partnership in SSA in Water and Electricity

In Africa 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 the utilities under leases or concessions contracts without actually owning any asset in firm. For instance the World Bank has often favoured performance management contracts, rather unsuccessfully. The paper extents the definition of Public Private Partnership (PPP) to encompass all situations where the private sector is involved into the provision of utilities services, whether it is formally or not. We use the words "privatization" and "private participation" to refer to the situations where a private operator provides utility services. This ranges from official contracts between government and international firms to *laissez-faire*. Official forms of PPPs 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.

B1. Typology of Private Sector Participation in Water Utilities.

1. International Operators in Big Cities (contract[31] in operation or to be signed):
   - Ivory Coast (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 urban cities)
   - Senégal (affermage with concession elements signed with Saur in 1996; renewed in 2006)
   - Gabon (20-year concession contract signed with Véolia 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 Véolia in 2001)
   - Maroc (Ondéo in Casablanca / Véolia in Rabat-Salé and Tanger-Taitouan)

31 Operating and Maintenance or Management contracts in italic.

- *Zambia (Copper Belt: management contract with Saur in 2001. Still in operation?)*
- *Rwanda (5-year management contract signed in 2003 with Lahmeyer)*
- Cameroun (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 Véolia / 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 centres; 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)
- Republic of Centrafrique (affermage contract signed with Saur in 1991; terminated by Saur)
- *Tchad (Véolia signed a 30-year management contract in 2000 which was supposed to evolve through a privatisation process; terminated by Vivendi in 2004)*
- Cap Vert (50-year concession contract signed with Aguas de Portugal; in crisis)
- Tanzania (Dar es Salam : the lease contract signed with Biwater in 2003 was terminated by the government in 2005)
- *Uganda (management contract with Ondéo 2002-2004 for Kampala)*
- *South Africa (Johannesbourg : 5 year management contract with Ondéo 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 (contract[1] still in operation):
- *Kenya (Malindi – O&M contract signed with Gauff in 1995, followed by a management contract in 1999)*
- South Africa (*Queenstown : O&M contract signed with Ondéo* 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 finalised yet)

4. Small Scale Providers Documented in Small Cities:
- Ghana
- Mauritania

- Uganda
- Zambia
- Tanzania
- Niger

5. Small Scale Providers Documented in Periurban Areas:
- Tchad
- Mali
- Kenya (Kibera, Kisumu)
- Mozambique
- Tanzania
- Nigeria
- Angola
- Benin
- Burkina Faso
- Ivory Coast
- 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
- Tchad

B2. Typology of Private Sector Participation in Electricity Utilities in Africa (without IPP).

1. International operators in Big Cities (contract[32] in operation):
- Gabon (20-year concession contract signed with Véolia in 1999)
- Cameroun (20-year concession contract signed with AES in 2001)

[32] Operating and Maintenance or Management contracts in italic

- Ivory Coast (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 privatisation was unsuccessful)
- Cap Vert (50-year concession contract signed with Aguas de Portugal; in crisis)
- 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 centres; terminated by Saur in 2005)
- *Tchad (Véolia signed a 30-year management contract in 2000 which was supposed to evolve through a privatisation 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-years 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:
- Ivory Coast
- Senegal
- Somalia
- South Africa
- Tanzania
- Ethiopia
- Ghana
- Kenya
- Mali
- Mozambique
- Zimbabwe

APPENDIX C: Proof of Proposition 3

By assumption

(i) $K < K^{RP/PM}(\lambda) \Leftrightarrow L(\lambda) = EW^{RM}(\lambda) - EW^{PM} > 0$

where

$$L(\lambda) = 2\frac{(1+\lambda)^2}{1+2\lambda}V^{RM}(\lambda) - \lambda K + \frac{3}{4}V > 0$$

and $V^{RM}(\lambda) + \dfrac{E\left[\left(a - \dfrac{1+2\lambda}{1+\lambda}\right)^2\right]}{4b}$ so that

$$V^{RM}(\lambda) + \frac{1}{4b}\left[a^2 + \left(\frac{1+2\lambda}{1+\lambda}\right)^2 \frac{\overline{C}^3}{3} - \frac{1+2\lambda}{1+\lambda}a\overline{C}\right]$$

Substituting $V^{RM}(\lambda)$ in $L(\lambda)$ yields:

$$L(\lambda) = \frac{(1+\lambda)^2}{1+2\lambda} \quad \frac{a^2}{2b} + \frac{l+2\lambda}{2b} \quad \frac{\overline{C}^2}{3} - \frac{a\overline{C}}{2b}(1+\lambda) - \lambda K - \frac{3}{4}V$$

Let $V = \dfrac{l}{4b}\left[a^2 + \dfrac{\overline{C}^2}{3} - a\overline{C}\right]$

and $V^{RM}(\infty) = \dfrac{E\left[(a-2C)^2\right]}{4b} = \dfrac{1}{4b}\left[a^2 + \dfrac{4\overline{C}^2}{3} - 2a\overline{C}\right]$

We deduce that:

$$L(\lambda) = \frac{a^2}{2b}\left[\frac{(1+\lambda)^2}{1+2\lambda} - \frac{\lambda}{2} - 1\right] + \lambda\left[V^{RM}(\infty) - K\right] + 2V - \frac{3}{4}V - \lambda K$$

This is equivalent to:

$$L(\lambda) = -\frac{\lambda}{1+2\lambda} \quad \frac{a^2}{4b} + \lambda\left[V^{RM}(\infty) - K\right] + \frac{5}{4}V - \lambda K$$

We deduce that:

$$L'(\lambda) = \frac{-a^2}{4b(1+2\lambda)^2} + V^{RM}(\infty) - K$$

This implies:

$$\begin{cases} L'(0) = -\dfrac{a^2}{4b} + \dfrac{E\left[(a-2C)^2\right]}{4b} - K < 0 & \text{under } A1 \\ L'(\infty) = V^{RM}(\infty) - K > 0 & \text{under } A2 \end{cases}$$

Moreover

$$L''(\lambda) = \frac{a^2}{b(1+2\lambda)^3} > 0 \qquad \forall \lambda \geq 0$$

We deduce that $L(\lambda)$ reaches its minimum for λ^* so that $L'(\lambda) = 0$. It is straightforward to check that

$$\lambda^* = \frac{1}{2}\left[\frac{a}{\sqrt{(V^{RM}(\infty) - K)4b}} - 1\right].$$

Let $a=2\overline{C}$. One can check that $V^{RM}(\infty) = a^2/3$. We deduce that $\lambda^*_{|k=0} = \dfrac{\sqrt{3}-1}{2} \simeq 0,366$ and that $\lambda^*_{|K=\frac{a^2}{18b}} = 1$.

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