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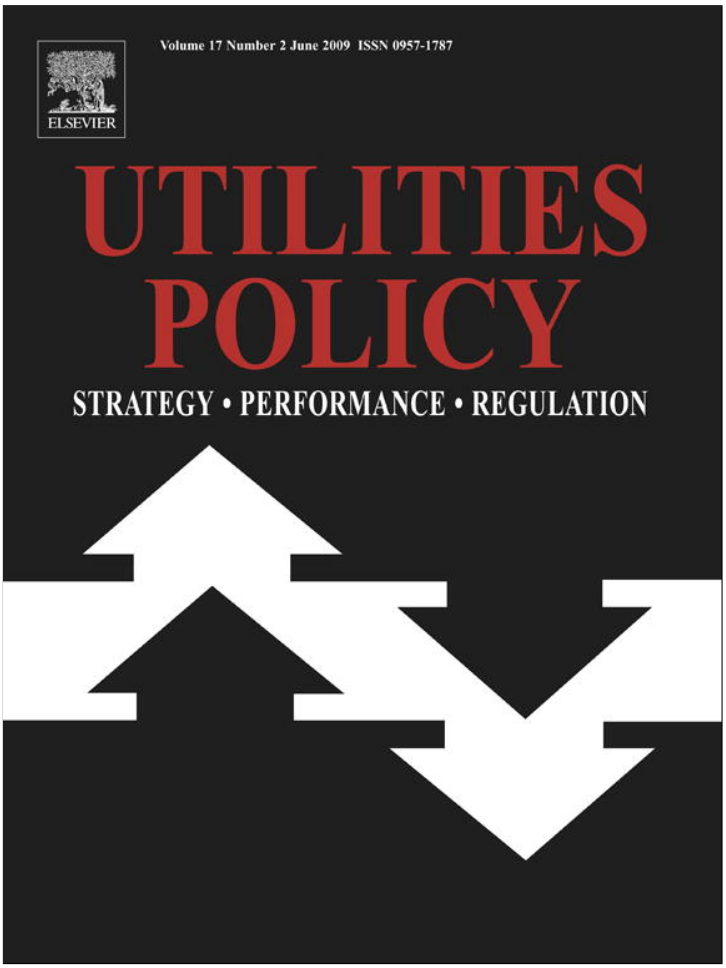

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Capture and corruption in public utilities: The cases of water and electricity in Sub-Saharan Africa

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ABSTRACT

The paper focuses on public utilities services located in poor countries with a special attention to capture and corruption issues. It confronts the optimal policy of Auriol and Picard [Privatization in Developing Countries and the Government Budget Constraint, Nota di Lavoro 75.2002. Fondazione Eni Enrico Mattei, Milan, Italy] regarding private sector involvement in public utilities with empirical evidence on water and electricity in Sub-Saharan Africa (SSA). As predicted by the theory, the participation of private unregulated firms in the supply of services for the middle class and poor people is fairly common in SSA. By contrast, services for rich people are provided by public utilities. Theory suggests that their prices should be high so that the public firms make a profit. Yet piped water and electricity are subsidized. This suggests that there is a problem of capture by the ruling elite. Since ruling elites design privatization programs, there is concern about their optimality. The paper shows that the social cost of corrupted privatization is non-monotone in the opportunity cost of public funds. Because of the fiscal loss it represents, privatizing profit centers of public firms entails huge social costs in very poor countries.
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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 fueled the hope that the private sector would be the future provider of investment in infrastructure and public utilities in poor countries. Ten years later the financial flows involved in this process are sobering.[2] Assessment of privatization reforms is mixed and varies widely depending on the assessor. Since they have often led to improvements in the financial and operating performances of divested firms, some 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 28–August 3 2001, p. 38). Similarly in Africa, reforms have been described 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 analyzes the impact of corruption in privatization decisions regarding public utilities located in developing countries.

Anecdotal evidence suggests that the corruption problem in privatization programs is real. However, it is hard to uncover and quantify empirically. This paper draws on the normative analysis of Auriol and Picard (2008) to address the corruption issue and its welfare implications. It proceeds in two steps. Auriol and Picard (2008) study the relationship between the financial constraints of a country and its *optimal* industrial policy in infrastructure and

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

[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 and equity issuance (World Bank, 2004). International private capital flows will not fill the huge investment gap in poor countries' infrastructures

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utilities industries. It provides a benchmark against which governments' industrial policy can be assessed. The null hypothesis is that governments follow the optimal industrial policy derived in the paper. This supposes that they are benevolent when managing their public utilities. In a first step, the hypothesis is tested by confronting the model theoretical predictions with the available empirical evidence 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 thus compares the optimal pricing scheme to actual prices in water and electricity in several African countries. It concludes that capture is occurring in public utilities.

To be more specific, the theoretical predictions of Auriol and Picard (2008) vary with the profitability of the market segments concerned. In unprofitable segments, Auriol and Picard (2008) 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%, notably the same level as 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 (2008) 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 service provision should be left to private providers. Consistently with the theory, participation of private firms in the supply of utilities services is fairly common in Africa. In peri-urban areas, 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 how much profit they could make out of the fairly inelastic, uncompressible part of the demand. In some African cities, water supply to the poor is a textbook case of monopoly abuse. In electricity, self-sufficiency based on private generators and privately owned and operated small electricity networks closes 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 solution to let private providers cater to 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 from the wealthy part of demand to subsidize access by 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 neighborhoods. They focus on rich consumers so that in general only the fifth quintile (i.e., the 20% wealthiest consumers) has 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 implies that the government is either incompetent or not benevolent. Since the price mechanism has been captured by the ruling elite, we favor the latter conclusion. The social cost of this capture is high. Public utilities are losing money. They are unable to invest. The problem is particularly acute in electricity where the access rate is half that in peer low income countries (i.e. 24% as opposed to 48%).[3]

The first part of the analysis establishes that the price setting mechanism has been captured by the ruling elite. We are thus obliged to reject the null hypothesis that African governments manage their public utilities efficiently. The problem is that the ruling elite is not just responsible for fixing prices in public utilities, but it also designs and implements privatization programs. It is thus legitimate to be skeptical regarding the optimality of privatization programs. In a second step, the paper studies what happens if the government privatizes—possibly in exchange for bribes—a profitable firm's segment which, according to normative analysis, should remain public. The paper derives analytically the social loss formula: It depends on the opportunity cost of public funds. The loss formula is U-shape and diverges with the opportunity cost of public funds. In other words, the social cost of corruption in privatization programs is much higher in poor countries than in middle-income ones. The intuition for this result is as follows. Privatizing public utilities' profit centers represents a permanent loss of revenue for the government. Yet in very poor countries, government revenue is very small (10% of GDP). The fiscal loss implies by the privatization leads to a decrease in spending on essential public goods, infrastructure, schooling and health care. When spending is already dismally low, the social cost of public finance contraction is huge. The result helps to explain the unpopularity of the reforms. In practice, inefficient privatizations do occur in poor countries and entails 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 (2008) macro-fiscal balancing results. Section 4 tests the theoretical implications of the model by contrasting them with available empirical evidence on the provision of water and electricity in Sub-Saharan Africa. Section 5 presents an analysis of corruption in privatization. Section 6 concludes.

2. Privatization and internal efficiency of the firm

2.1. Productive efficiency

The 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) and Kornai et al. (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 (1997), and 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 malevolent. The main conclusion of this theoretical literature is that privatization improves firms' internal efficiency. Empirical evidence tends to support this result. Megginston and Netter (2001)

[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).

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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 a fifth and a third 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 tended to improve firms' performance.

In developing countries, the gains from private sector involvement stem from better asset management and bills recovery. Andres et al. (2006), who studied the impact of privatization of electricity distribution in 116 cases in 10 Latin American countries, show that privatization generates improvements in labor productivity, efficiency and product/service quality. These good performances, which mostly occurred in the transition period between the public and the private system, have been achieved through substantial job cuts (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 5-year period, average plant availability in their sample increased 10–40%, outage indicators decreased by more than half, and the number of customers per employee increased by 50%. In Sub-Saharan Africa, where private operators have taken over retail supply, they have reduced payment delays, theft, and unpaid bills. For instance unpaid bills were reduced from 30% to 12% for the 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, 2006). In Senegal, the network commercial rate (water paid over water produced) improved from 68% in 1996, a year in which a 10-year lease contract was signed with SAUR, to 80% in 2006. Gassner et al. (2007) evaluate the impact of private sector participation (PSP) on firm performance in electricity distribution and water and sanitation services with a selection of 302 utilities with PSP and 928 utilities without PSP in 71 developing and transition countries. They find that PSP decreases employment, has a strong impact on the efficiency of utility operations, bill collection ratios and improvement in the quality of service.

2.2. 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. 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 cost reductions they generate for themselves.[4] Empirical studies thus 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 sd 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 rates in Zimbabwe, Kenya and Senegal. In Senegal the government increased rates 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 in coverage and output once the authors had checked for firm-specific time trends. Although prices were hard to compare across companies, the results also suggest a rise in prices (Andres et al., 2006). Finally a review of the World Bank Group's experience with private participation in the electricity sector shows that rates decreased for industry and commerce but have risen for other customers (Manibog et al., 2003).

2.3. Regulation

In increasing return to scale industries, such as water or electricity networks, regulation literature recommends that a legal monopoly is 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 highlights 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 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 the 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. (Zhang et al., 2002)

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 necessary to control large corporations. For instance in Latin America, the concessions granted to private operators following the divestiture of public firms were renegotiated after an average of only 2.1 years (see Laffont, 2001; Guash et al., 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

3.1. Opportunity cost of public funds

Government pursues multiple objectives, such as the production of public goods, the regulation of non-competitive industries or the

[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% 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 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 shareholders' profit (see Birdsall and Nellis, 2002).

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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 marked 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) as opposed to 18.2% for developing countries (based on a sample by 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 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 (2008) 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 private firms assume responsibility for the firm's cash flows. One benefit of privatization is that it reduces government subsidies to money-losing 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 creates a cost for consumers. Privatization in developing countries is thus 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 yes. When public finance matters, privatization without price control can dominate a benevolent regulation. Auriol and Picard (2008) consider both monopoly and duopoly structure. For the sake of simplicity, we focus on the monopoly case here. As explained in Section 4, it is more realistic in the case of Sub-Saharan Africa utilities because they generally operate below efficiency level of scale.

3.2. 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. For the sake of simplicity, it is assumed here to be independently drawn from the support $[0,\bar{c}]$ 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:

$$\Pi(Q) = P(Q)Q - cQ - K + t \tag{1}$$

where $P(Q)Q$ is the sales amount and t is the net transfer that it receives 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 a corner solution in the sequel it is assumed that

A1 $$a \geq 2\bar{c}$$

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:

$$W = S(Q) - cQ - K - \lambda t \tag{2}$$

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 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 with regulation, marked R, government's control rights on prices and quantities are associated with accountability on profits and losses. That is, it must subsidize the firm when there are losses whereas it taxes the firm when there are profits. In contrast, in the private system, marked P, the government imposes no control on prices and quantities, and takes no responsibility for the firm's profits or losses. Transfers between the government and the private firm are therefore ruled out.

Under private ownership the firm pays the sunk cost K, and chooses the *laissez-faire* monopoly quantity; $Q^P(c)=(a-c)/(2b)$. Under public ownership the government pays the sunk cost K, and chooses the regulated monopoly quantity, which under the situation of asymmetric information is: $Q^R(c)=(1+\lambda)/(1+2\lambda)(a-c_v)/b$, 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 evidence, private firms are here more efficient than public firms. It is straightforward to check that when $\lambda=0$ the government, which maximizes consumers' surplus, chooses $Q^R(c)=Q^*(c)=(a-c)/b$. This is the first best quantity obtained when price P^R 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 $Q^R(c)=Q^P(2c)<Q^P(c)$ and $P^R(c)=P^P(2c)>P^P(c)$. 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: $E\Pi^P=V-K$. The *ex-ante* welfare level under private ownership is

[5] The opportunity cost of public funds is a static concept. It is different from the marginal cost of public funds (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 and Auriol (2005) estimate that the average MCF is equal to 1.19 in SSA.

[6] Auriol and Picard (2008) consider general distributions of marginal cost.

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$$EW^P = 3/2V - K \tag{3}$$

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

$$EW^R(\lambda) = (1+\lambda)\left\{(2+2\lambda)\Big/(1+2\lambda)V^R(\lambda) - K\right\} \tag{4}$$

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 $EW^P > \max\{0, EW^R(\lambda)\}$.

Fig. 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^R represents the limit values of K above which the regulated monopoly is no longer valuable (i.e., such that $EW^R < 0$) Ø. The curve $K^{R/P}$ represents the limit values of K under which the regulated monopoly is preferred to the private monopoly (i.e., such that $EW^P < EW^R$). In the hatched area marked P the private unregulated monopoly is the optimal industrial policy; in the white area marked R the optimal policy is the public regulated monopoly.

4. Testing the model predictions: Water and electricity in Sub-Saharan Africa

Auriol and Picard (2008) 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). This paper aims to test whether developing countries governments behave benevolently while managing their public utilities or not. 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 evidence on industrial organization, mainly from World Bank and 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.

4.1. 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 a *local* natural monopoly because each city constitutes a distinct market. At national level, there are usually a multitude of local monopolies with different type of contracts and statuses. However, at international level, the water industry is very concentrated. There are only four major companies operating in Sub-Saharan Africa: Thames Water, Vivendi, ONDEO, and SAUR, and two more at worldwide level (Anglia Water and Yorkshire Water). Electricity networks tend to constitute *national* (or even regional) natural monopolies 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 Estache et al., (2008) study electricity generation between 1998 and 2001 in 13 countries (mostly East African). They show that inefficiencies of scale are in the order of 24%. This result suggests the need 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.[8] 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 unsuccessful. Re-concentration into larger entities has been necessary in several cases (Manibog et al., 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. Doubling the population served 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 suggest the need 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.

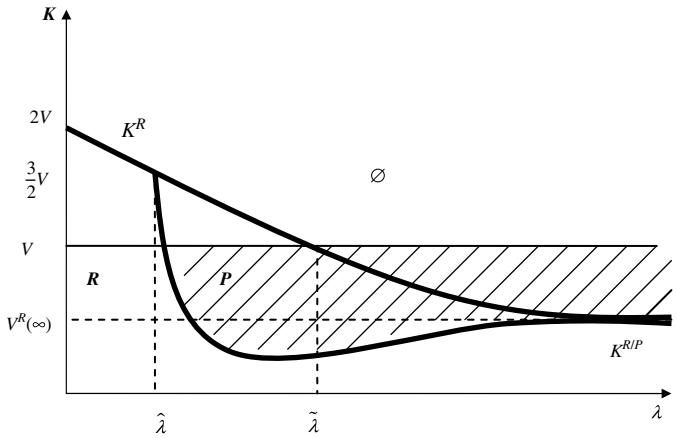

Fig. 1. Optimal industrial policy for the monopoly case.

4.2. Theoretical results

Fig. 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 $\lambda > \hat{\lambda}$, $K^R > K^{R/P}$). The relevance of the privatization result depends on what "intermediate" values means. If they are very high, in practice privatization 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 $\bar{c}/a$. This ratio measures the *ex-ante* technological uncertainty. Indeed with a uniform distribution uncertainty rises with $\bar{c}$ (i.e., $\sigma^2 = \bar{c}^2/12$). In Sub-Saharan Africa

[7] In the European electricity market, 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). According to the European Commission (2005), among the EU-15, concentration in generation and 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%.

[8] 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 any more.

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cost/demand uncertainty are exceptionally high, as shown by international risk rating agencies. To take into account the SSA-specific context we need to consider large values of $\bar{c}$. In what follows we hence consider the lower bound of A1. The next result is shown in Appendix A.[9]

Proposition 1: Let $\bar{c} = a/2$, *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 classified as heavily indebted poor countries (HIPCs), most of them in Sub-Saharan Africa.[10] In other words, under the model assumptions, most Sub-Saharan countries are on the right side of $\tilde{\lambda}$ in Fig. 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) $K^{R/P}(\lambda) < K \leq V$: service is private and price is unregulated $P^P(c)$.
(iii) $K \leq K^{R/P}(\lambda)$: service is public and the regulated price, $P^R(c)$, increases with λ so that $P^R(c) > EP^P(c)$ for $\lambda > a/\bar{c} - 0.5$.

The paper predictions which can be tested with stylized facts concern ownership structure (public or private), regulation of price (presence or absence) and 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.

4.3. Model predictions

4.3.1. Unprofitable segment

The unprofitable part of the market is depicted on the upper part of Fig. 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 marked R which is under curve K^R and above line V. The no production area, which is labeled ϕ, is above curve K^R and the profitability line V.[11] We deduce from Propositions 1 and 2:

Prediction (i): In poor Sub-Saharan African countries there is no service in unprofitable market segments (neither private nor 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 areas 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 African Development Bank on 13 Sub-Saharan countries thus shows that 63% of household energy consumption was wood in 1994.[12] 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 Africans did not have access to improved water sources.[13] Among the 56% of Africans who had access to "safe" water, 40% rely on a borehole, public standpipe, protected dug well, protected spring, or rainwater collection. In other words, 84% of Africans had no connection to a 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.[14]

4.3.2. Low profitability segment

When K varies between $V^R(\infty)$ (i.e., the limit value of $K^{R/P}$ 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 close to utilitarian social welfare. On the other hand, when the opportunity cost of public funds is high, the government objective function is tilted 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 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. 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 favored 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 infrastructure, and let people use it at marginal cost. With a low opportunity cost

[9] Auriol and Picard (2008) do not compute $\tilde{\lambda}$. Yet they show that $\hat{\lambda}$ varies between 0.35 and 1.14 when $\bar{c}$ varies between $a/2$ and $a/10$.

[10] See Official HIPC website.

[11] When $\hat{\lambda} < \lambda < \tilde{\lambda}$ for the area which is comprised between the curve $K^{R/P}$ and K^R 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 intermediate revenue countries to subsidize private firms to serve this unprofitable segment.

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

[13] 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.

[14] Children walk hours to assist their parents in these chores. For instance a study conducted in 2002–2003 in rural Guinea reveals that children aged between 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).

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of public funds, this policy maximizes welfare. By contrast countries plagued by financial problems cannot follow this strategy. Private provision of utilities services is thus fairly common in SSA.

Formal privatizations and public and private partnerships (PPP) between governments and international firms have attracted much attention and mobilized a great deal of resources from international organizations.[15] 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 1990–2003 period greenfield contracts (Build Operate and Transfer) have been the most popular type of PPP. Appendix B reviews these PPP. Not only the reforms have been expensive to design and implement, but they were also often unsuccessful. A striking example is EDM in Mali where a management and a concession contract have successively been signed and terminated over ten-year period. The result is a tremendous backlog in water and electricity. 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. (Tremolet, 2005)

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. However, they are filling the service gap in low profitability segments.

In the water sector returns to scale are lower than in electricity. Since it is easier to produce a service at a 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 thus 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 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.[16] 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.[17] 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 carters 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. This extreme form of privatization, which yields a very high cost per kWh, occurs because the power shortage is acute. *Investment Climate Assessments* (ICA), which draw upon the results of enterprise surveys to prioritize constraints to business, show that 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. As a result 40% of the establishments surveyed in the region own or share a generator.[18] The surveys underestimate the problem posed by the SSA power crisis because once they are self-sufficient firms tend to focus on problems other 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" scores in the sample) among the 19 possible constraints. Moreover the number of surveyed establishments in each country is small (266 on average). The selection, which is based on tax records, targets firms from big cities and the formal sector. Informal businesses and rural areas which are the core of Sub-Saharan economy are not included in the surveys. Finally the study does not consider domestic consumers. They often rely on small-scale providers for basic lighting services and/or for batteries.

Until now, economists and international organizations have overlooked 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 encourage them to expand their services and become formal, notably by lending them money,[19] while in exchange controlling their prices. A good example can be found in the 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.[20]

4.3.3. 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 sell them off. Prices are set close to the private monopoly level in order to maximize profit and thus

[15] 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).

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

[17] Dardenne (2006) argues 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 because costs are higher and are not subsidized.

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

[19] Kariuki and Schwartz (2005), show that small-scale private providers of water and electricity are severely credit constraint.

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

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government revenue. The fiscal argument works for every country in the world. Governments of advanced economies care about the revenues generated by their utilities.[21] The difference between them lies in 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.

> 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 (IEA). 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 the 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 the average access rate at 8%; the IEA estimates it at 5%. The discrepancy in the estimates is not surprising. It reflects the shortage of hard information available on the region. The IEA, which collects information on energy worldwide, is usually fairly exhaustive. Yet it does not provide any information on many SSA countries.[22] Whatever the exact level satellite pictures at night clearly show that, with the exception of South Africa and some capital cities, the continent is devoid of electric power.[23] Similarly in 2004 the percentage of household with a connection to a piped water network was estimated at 16% in SSA. In sanitation, the percentage of households with access to a sanitation network was estimated to be about 8% by the WHO/UNICEF monitoring program.[24] Consistent with (*iii*) it is rich people that are connected to public utilities. 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. In the fourth quintile, connection rates 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 a positive access rate in all of the countries. In other words, the access rate to piped water is almost 0% in the first three quintile of income group in 21 countries. This figure is consistent with the WHO/UNICEF statistics which put the share of Africans with access to piped water at 16%.

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 per cubic meter in SSA. For instance a study in the city of Niamey shows that households pay on average FCFA 645/m^3 in the first quintile, FCFA 541/m^3 in the second, FCFA 509/m^3 in the third, FCFA 422/m^3 in the fourth and FCFA 249/m^3 in the fifth. Differences are even larger if shares of water budget in the household budget are compared (Bardasi and Wodon, 2006). Similarly 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. It has been estimated that water utilities 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 the elimination of investment in maintenance and network extension. With the poor paying up to ten times the price paid by the rich, doubling the price of piped water in Sub-Saharan Africa and collecting the bills is not just a matter of efficiency, it is also a matter of justice. Such increases in rates are possible because they have been implemented in many other developing countries. For instance in Uruguay, residential water rates were raised in nominal terms at an average annual rate of 25% (15% in real terms) over the period 1997–2003 (Foster and Yepes, 2006). Rates increases 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 69% of low income countries achieve some degree of cost recovery in electricity, while only 12% do so in water. This difference is explained by the fact that electricity rates are proportionally higher than water rates. Average electricity rates 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, rates are too low to fully recover the costs. To be able to invest more, the public utilities rates have to be raised. For instance in Rwanda the kWh price has been multiplied by two by the national electricity firm.[25] There is no point in raising rates 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 access is too low in the long run. 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 the access rate in SSA is half that 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

[21] 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 US$5. 185 billion in fiscal year 1999 (reported in budget of the United States Government, fiscal year 2000).

[22] 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

[23] See http://www.junglephotos.com/africa/afspace/continent/africaday.shtml

[24] See http://www.wssinfo.org/en/333_san_africaS.html.

[25] Electricity utilities should also develop non linear rates for large customers, such as peak load pricing, to smooth demand and to deal more efficiently with the shortage of power. Non linear rates are also useful to maximize profit and shield the poorest consumers from the burden of necessary price rises. Contrary to water, there is some evidence of a positive relationship between consumption of electric power and wealth. Sophisticated pricing policies obviously require metering of consumption.

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are managing their public utilities optimally. 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)

Corruption in privatization programs has been documented in many developing countries. This is the case in Latin America.[26] 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. In SSA, the 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 rumors 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.[27] 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 rush to comply, some bad deals might have been concluded.[28]

Corruption and/or incompetence in privatization yield costs both for taxpayers and 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 the social welfare would have been if the most efficient industrial structure had been adopted. We rely on theoretical analysis to uncover this 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 Fig. 1. Indeed in this case public ownership dominates private ownership. The welfare loss generated by inefficient privatization is denoted $L(\lambda) = EW^R(\lambda) - EW^P$. It depends on the opportunity cost of public funds. Let $V^R(\infty) = E[(a-2c)^2]/4b$. The next result is shown in Appendix C.

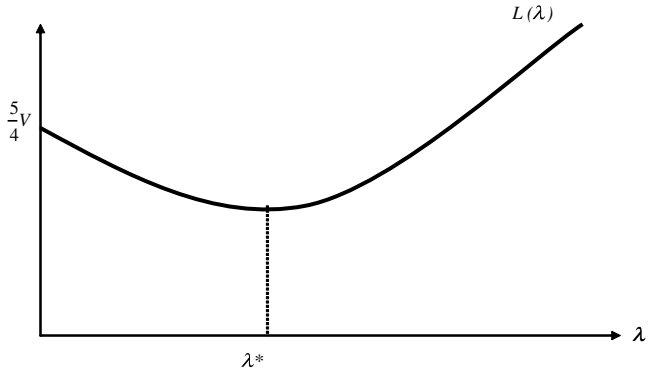

Fig. 2. Loss function of inefficient privatization.

Proposition 3: Let $K \leq K^{R/P}(\lambda)$ and let $\lambda \geq \widehat{\lambda}$. The loss function of privatization is

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

Fig. 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 $\bar{c} = a/2$, 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: $E\Pi^P = V - K$. By contrast the social loss depends on the opportunity cost of public funds. It is unbounded and diverges with λ: Losing public utilities profit centers is socially 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 have previously shown, inefficiencies occur in the management of public utilities. Nevertheless a corrupt government will choose to privatize profit centers and the best performing public firms. To maximize the bribes it will grant exclusive monopoly to the bribers.

It is hard to find direct empirical evidence to assess the result of Proposition 3. However, one can rely on indirect evidence. First of all, the theory predicts that inefficient privatization yields a fiscal cost. In practice restructuring of public utilities, aimed at encouraging private participation in developing countries, has resulted in cream-skimming. Private investors have targeted profit centers. They 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 centers used to finance cross-subsidies were handed out to the private sector (Estache and Wodon, 2006; Trujillo et al., 2003). Another result is to exacerbate regional disparities when territorial cross-subsidies are abandoned.[29]

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 (i.e., in case (*ii*) in Proposition 2). However for profitable segments (i.e., for $K \leq K^{R/P}(\lambda)$) the combination of allocative inefficiency and critical budgetary conditions favor 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

[26] For a theoretical analysis see Martimort and Straub (2007) and for an empirical test, see Bonnet et al. (2007).

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

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

[29] 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 Ivory Coast, 600 semi-urban centers are operated with a cross subsidy scheme at national level.

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governments should find difficult to attract investors simply because they sell the least profitable segments of their public utilities. By contrast corrupted government should more easily attract private investors because they focus on selling public firms profit centers. Consistently with this result, Ghosh Banerjee et al. (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.

The last piece of evidence concerns the popular perception of privatization. Since inefficient privatizations entail large social costs, they should be unpopular. In developing countries there is therefore 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 polling firm Latinobarometro, which conducts surveys each year 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 strong popular opposition to privatization policies (Kikeri and Kolo, 2005). Privatization reforms have even been described, 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 governments have been overturned by the unpopularity of the reforms. Some specialists who still think that the reforms have been successful assume that they have been misunderstood. People are unhappy with privatization because of irrational belief and ideology. However, African people are not against private providers. Utilities services are indeed 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 among their customers. They are close to the people and responsive to their needs (notably in payment schemes). Consistent 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 to them. Over the 1992–2003 period, the continent managed to attract only 4% of total international investment in infrastructure (World Bank, 2004).[30] Private firms were demanding a rate of return of 16% or more. The secrecy with which many sales were concluded fuelled the public perception that privatization benefited foreign investors or local entrepreneurs with political connections. Discouraged by the unpopularity of their action and the consequent changes in policy (see Harris, 2003), many of them have brutally retreated from 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.

6. Conclusion

The paper focuses on private provision of public utilities services located in poor countries with special attention to capture and corruption issues. It confronts Auriol and Picard (2008) optimal policy regarding private sector involvement in public utilities with empirical evidence on water and electricity in SSA. It helps to distinguish three 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 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 rate of return infrastructures.[31] Second, services provision is more market oriented in SSA than in OECD countries. Indeed the middle class and poor people are generally not connected to public utilities, so they do not receive any subsidies. They receive a service because they are prepared to pay for it and because local businesses are prepared to invest to provide it. In light of the financial constraint faced by most African governments, it is a second best solution 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 efficient management of scarce public funds. So it is wrong to stigmatize small private providers because their prices are high. They offer an important service that the government is unable to provide. The paper helps to highlight 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 therefore shows that prices are set to favor the powerful and wealthy rather than taxing them. In other words, 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 the design of public utilities reforms such as privatization is not a trivial matter. They must take into account the fiscal constraint faced by developing countries. Privatizing profit centers or profitable public firms in exchange for bribes entails huge social costs in very poor countries. The analysis therefore highlights that there are socially good privatizations and that there are socially 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 bring about and are very unpopular.

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Appendix A. Proof of Propositions 1 and 2

Proof of Proposition 1

Auriol and Picard show that when $c=0$ and $\overline{c}=a/2$ then $\widehat{\lambda}=0.35$.[32] To complete the proof of Proposition 1 we need to show that $\tilde{\lambda}=1$.

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

[31] It is worth noting that advanced economies do not provide access to tap water and electricity for 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 a more densely populated area.

[32] Auriol and Picard (2008) rely on simulation to compute the threshold value $\widehat{\lambda}$. Depending on the technological uncertainty (e.g., on $\overline{c}$ varying between 0 and $a/2$), it lies in [0.35, 1.14].

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$$\tilde{\lambda} \quad st \quad K^R(\lambda) = V \quad \Leftrightarrow \quad 2\tfrac{1+\lambda}{1+2\lambda}V^R(\lambda) = V \tag{i}$$

Substituting

$$V = \frac{E(a-c)^2}{4b}$$

and

$$V^R(\lambda) = \frac{E\left(a - \frac{1+2\lambda}{1+\lambda}c\right)^2}{4b}$$

into (*i*) yields after some straightforward computations:

$$0 = 2\lambda^2\ E(c^2) - 4\lambda(1+\lambda)E((a-c)c) + (1+\lambda)E(a-c)^2 \Leftrightarrow 0 = 2\lambda^2\frac{\bar{c}}{a}\left(\frac{\bar{c}}{a}-1\right) + \lambda\left(\left(\frac{\bar{c}}{a}\right)^2\frac{5}{3} - 3\frac{\bar{c}}{a} + 1\right) + 1 + \frac{1}{3}\left(\frac{\bar{c}}{a}\right)^2 - \frac{\bar{c}}{a} \tag{ii}$$

Let

$$\frac{\bar{c}}{a} = \frac{1}{2}.$$

Equation (*ii*) is equivalent to:

$$-6\lambda^2 - \lambda + 7 = 0$$

This second degree equation admits two roots:

$$\lambda^- = -\frac{14}{12}$$

and

$$\lambda^+ = 1$$

Proof of Proposition 2

Part (*i*): $K > V$ implies that private production is not possible, and $\lambda > \tilde{\lambda}$ implies that $K^R(\lambda) < V$ because $K^R(\lambda)$ is decreasing in λ (see Auriol and Picard, 2008) and $\tilde{\lambda}$ is such that $K^R(\lambda) = V$, so that public production is suboptimal.

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

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

$$P^P(c) = a - b\ Q^P(c) = \frac{a+c}{2}$$

and

$$P^R(c) = a - bQ^R(c) = \frac{\lambda}{1+2\lambda}a + c$$

We deduce that

$$EP^P(c) = \frac{a+Ec}{2} = \frac{a+\bar{c}/2}{2} \quad and \quad EP^R(c) = \frac{\lambda}{1+2\lambda}a + Ec = \frac{\lambda}{1+2\lambda}a + \frac{\bar{c}}{2}.$$

$$EP^R(c) \geq EP^R(c) \Leftrightarrow \lambda \geq \frac{a}{\bar{c}} - \frac{1}{2}$$

Appendix B. Public Private Partnership in SSA in water and electricity

In Africa it has been difficult to attract international investors. Private participation in traditional public utilities has not been limited to investment. Many private firms have been involved in the management of utilities under leases or concessions contracts without actually owning any asset in the firm. For instance the World Bank has often favored performance management contracts, rather unsuccessfully. The paper extends the definition of Public Private Partnership (PPP) to encompass all situations where the private sector is involved in 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*. 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.

B.1. Typology of private sector participation in water utilities

1. International operators in big cities: contract in operation or to be signed[33]
   - 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)
   - *Zambia* (*Copper Belt: management contract with Saur in 2001*)
   - Cameroun (affermage with publicly-owned ONEP since 2007)
   - *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, extended until end of 2007; next phase still unclear*)
2. International operators in big cities: contract terminated or not renewed[33]
   - 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)
   - 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 privatization 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)

[33] Operating and Maintenance or Management contracts in italic.

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- Uganda (management contract with Ondéo 2002–2004 for Kampala)
- South Africa (Johannesburg: five-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
- Rwanda (5-year management contract signed in 2003 with Lahmeyer)
- Madagascar (management contract with Lahmeyer terminated)

3. International operators in small cities: contract still in operation[33]
   - 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 five-year affermage contract for four secondary cities: Beira, Quelimane, Nampula, Pemba. Public Offering for next phase not yet concluded)
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
   - Ivory Coast
   - Ethiopia
   - Ghana
   - Guinea
   - Mauritania
   - Niger
   - Nigeria
   - Democratic Republic of the Congo
   - Senegal
   - Somalia
   - South Africa
   - Sudan
   - Uganda
   - Zambia
   - Zimbabwe
6. Community-based providers documented in rural areas
   - Mali
   - Burkina Faso
   - Chad

B.2. Typology of private sector participation in electricity (without IPP)

1. International operators in Big Cities: contract in operation[33]
   - Gabon (20-year concession contract signed with Véolia in 1999)
   - Cameroon (20-year concession contract signed with AES in 2001)
   - 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 terminated or not renewed[33]
   - Senegal (concession contract signed with HydroQuébec/Elyo in 1999; terminated in 2000; further privatization 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 centers; terminated by Saur in 2005)
   - Tchad (Véolia 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
   - Ivory Coast
   - Senegal
   - Somalia
   - South Africa
   - Tanzania
   - Ethiopia
   - Ghana
   - Kenya
   - Mali
   - Mozambique
   - Zimbabwe

Appendix C. Proof of Proposition 3

By assumption

$$K < K^{R/P}(\lambda) \Leftrightarrow L(\lambda) = EW^R(\lambda) - EW^P > 0 \quad \text{(i)}$$

where

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

and

$$V^R(\lambda) = \frac{E\left[\left(a - \frac{1+2\lambda}{1+\lambda c}\right)^2\right]}{4b}$$

so that

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$$V^R(\lambda) = \frac{1}{4b}\left[a^2 + \left(\frac{1+2\lambda}{1+\lambda}\right)^2\frac{\bar{c}^2}{3} - \frac{1+2\lambda}{1+\lambda}a\bar{c}\right]$$

Substituting $V^R(\lambda)$ in $L(\lambda)$ yields:

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

Let

$$V = \frac{1}{4b}\left[a^2 + \frac{\bar{c}^2}{3} - a\bar{c}\right]$$

and

$$V^R(\infty) = \frac{E\left[(a-2c)^2\right]}{4b} = \frac{1}{4b}\left[a^2 + \frac{4\bar{c}^2}{3} - 2a\bar{c}\right]$$

We deduce that:

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

This is equivalent to:

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

We deduce that:

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

This implies:

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

Moreover

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

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

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

Let $a = 2\bar{c}$. One can check that $4b\,V^{RM}(\infty) = a^2/3$. We deduce that

$$\lambda^*_{|K=0} = \frac{\sqrt{3}-1}{2} \simeq 0.366$$

and that

$$\lambda^*_{|K=\frac{a^2}{18b}} = 1.$$

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