The Risk of Reform:
Privatisation and Liberalisation in the Brazilian Electric Power Industry

by

Sunil Tankha

Master in Public Affairs
The University of Texas at Austin, 1997

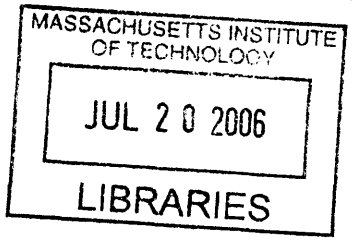
Submitted to the Department of Urban Studies and Planning in Partial Fulfilment of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY IN ECONOMIC DEVELOPMENT

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

February 2006



ROTCH

Signature of Author .....
Department of Urban Studies and Planning
August 22, 2005

Certified by .....
Alice Amsden
Professor of Political Economy
Dissertation Chair

Accepted by .....
Frank Levy
Chair, Ph.D. Program

The Risk of Reform:
Privatisation and Liberalisation in the Brazilian Electric Power Industry

by

Sunil Tankha

Submitted to the Department of Urban Studies and Planning in
Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy in Political Economy

ABSTRACT

In 1996, when Brazil was well-underway to privatising and liberalising its electric power industry, few would have predicted that within five years the reforms would be a shambles. Like its nighbours Argentina and Chile, Brazil based its electricity reforms on the orthodox therapies of privatisation and liberalisation. The industry was well-positioned to benefit from the reforms: it was technically sophisticated, relatively efficient, and attractive to both domestic and foreign investors. Electricity rates had been suppressed for a long time, but they were not populist and it was the residential customer who cross-subsidised industry. As such, political backlash to increasing electricity prices was unlikely and, in fact, Brazil had successfully begun to raise electricity rates as early as 1993. Despite these fortuitous circumstances, the reforms did not induce sufficient investment and Brazil suffered a massive electricity rationing in 2001. For ten months all classes of consumers had to cut consumption by 20%. By 2002, the electricity reforms were politically dead and none of the candidates in Brazil's presidential elections that year, not even the incumbent administration's nominee, favoured continuing with them. My dissertation explains why the reforms failed, approaching the issue from three different perspectives—the policy, the economic and the industrial. Collectively, these essays explain why sectoral neoliberal reforms had a short shelf-life.

Dissertation Chair: Alice Amsden
Title: Professor of Political Economy

ACKNOWLEDGEMENTS

My thanks go to:

My dissertation committee: Alice Amsden, Jose Antonio Gomez-Ibañez, and Ashley Brown.

Judith Tendler, my constant mentor.

Marty Rein, for brainstorming.

Antonio Magalhães, for Brazil.

All those who shared their couches and beds with me on my random reappearances in Boston—Bilal, Robin, Yanni, Sarah, Jill, Sarah P., Laura, Ariel, Genna, Jean, Uri, Nadya, Malo, Boyd, Leigh, Ian, Annie and the anonymous person who left the camp bed in the DUSP Common Room.

And of course, Tenzing, for facilitating most of those couches.

I would also like to take this opportunity to acknowledge the financial support of the Social Science Research Council, the John D. and Catherine T. MacArthur Foundation, the Center for International Studies and the Center for Energy and Environmental Policy Research at MIT.

Special thanks go to Jose Antonio Puppim de Oliveira and the Brazilian School of Public and Business Administration (EBAPE) at the Getulio Vargas Foundation (FGV) in Rio de Janeiro for hosting me during my field research.

Finally, I thank all the politicians, public officials, academics, consultants, and public and private energy company executives in Brazil for helpful discussions.

CONTENTS

Paper One

MUDDLING MEANS AND ENDS
The Short and Unhappy Era of Electric Power Privatisation in Brazil

> *All serious reflection about the ultimate elements of meaningful human conduct is oriented primarily in terms of the categories 'end' and 'means'*
>
> - Max Weber (1949)

1. Introduction

Like its neighbours Argentina and Chile, Brazil based its electric power reform on the orthodox therapies of privatisation and liberalisation. The Brazilian federal government initiated the reforms in 1993 and persevered with them until a lack of private investment in power generation led to a crippling energy crisis and forced the nation into mandatory power rationing in 2001. By 2002, the idea of persisting with privatisation was politically dead. None of the four major candidates in Brazil's 2002 presidential elections favoured continuing the process; not even the incumbent administration's nominee.

The results of the first seven years of electric power reform in Brazil are anomalous. Of all the Latin American countries, Brazil was one of the best-placed to benefit from orthodox reforms. First, many Brazilian power companies, especially the generation companies, were technically well-managed even under state control. By enabling a more supportive economic and commercial environment, orthodox reforms should have facilitated even more efficiency and investment. Second, power rates in Brazil were never populist in the traditional sense. Cross-subsidies in the electric power sector favoured large industrial consumers at the expense of residential and commercial customers. Political resistance to price rationalisation—which is generally one of the key barriers to implementing orthodox reform—was therefore unlikely. Third, the Brazilian federal government had already completed the basic and politically difficult reforms before initiating privatisation. Power rates had been raised and many of the state-owned power companies had begun streamlining their workforce, forcing hundreds of employees into retirement. Fourth, Brazil was one of the most important economies in Latin America, which should have facilitated the foreign investment necessary to cement orthodox reforms. Finally, the Brazilian government and policymakers had a wide range of experiences of orthodox reform implemented in other countries in Latin America and Europe from which to learn. Given these favourable factors, orthodox reform should have delivered immediate and self-reinforcing benefits.

Indeed, in the first few years of the reforms, it did appear that the reforms were headed in the right direction. Between 1993 and 1995, with the elimination of electricity rate controls, the conditions were set for the recovery of the financial health of the power companies. Subsequently, between 1995 and early 1998, most of the power distribution companies were privatised, many at substantial mark-ups over their minimum reserve prices.

By 1998, however, serious problems had begun to appear in the Brazilian electric power reforms programme. Privatisation of generation companies stalled in response to a combination of macroeconomic difficulties, political opposition and investor disinterest. Subsequently, the government's attempts to induce private investment in independent power projects (IPPs) also failed. In 2000, but for some providential rains and an economic slowdown caused by the collapse of the currency peg, Brazil would certainly have suffered power rationing. The administration did not take much advantage of this temporary relief and in May of the following year, warned by the Brazilian National Electric Systems Operator (ONS) that the hydropower reservoirs in most of the country were practically depleted, President Fernando Henrique Cardoso was forced to declare an emergency power rationing. All except the smallest residential customers were instructed to reduce their power consumption by at least 20%. The rationing lasted 10 months and cost the industry at least US$ 5 billion in lost revenue. Estimates of the loss in GDP caused by power rationing varied between 1.5 and 2 percent, which indicates a further loss of about US$ 10 billion to the Brazilian economy.

Given the tremendous losses caused by the flawed electric power reform programme, one could logically expect that the government would have used all available means to avoid the rationing. Indeed, the Cardoso administration in Brazil began electric power privatisation with the objective of ensuring sufficient and efficient investment in electric power generation. Yet, by the end of Cardoso's second term, investment in electric power was neither sufficient nor efficient, despite the fact that there was ample warning of an impending power shortage, despite the fact that resources were available to the federal government to promote investment in electric power and despite the fact that state-owned power generation companies were enjoying historically high profits and low debt (see Chart 1). The government could have dramatically reduced the chances of rationing had it been more proactive in using state muscle to build the needed power plants. Indeed, the administration did make considerable sums available to the sector but by insisting on funnelling most of it through the private sector it delayed investment and was unable to avoid the eventual power shortages. The question that guides this paper, therefore, is: why did the government persist with a privatisation strategy that was not delivering?

To answer this question and provide a more robust explanation for the anomalous results witnessed in Brazil, this paper examines the policy dynamics of Brazilian electric power privatisation. Its objective is not to explain why Brazil privatised its electric power industry but rather to explain why they persisted with the privatisation strategy after it had rapidly become obsolete. In doing so, the paper explains how the reformers' commitment to neo-liberal reform subverted the stated goal of Brazil's power reform—ensuring adequate capacity expansion—and substituted it by the strategy—privatisation—that had been adopted to pursue it. It shows how the Brazilian reformers charted out a path of neo-liberal reform predicated upon privatisation and strong money, which they believed was the best means to overhaul Brazil's economy.[1] In the

[1]It is important to clarify here the relevant actors in this analysis. When I speak of a political commitment to privatisation, I am referring to the Brazilian presidential administration and not the Brazilian legislature. In Brazil's federal system, presidential power has been limited ever since re-democratisation in 1984. Brazilian legislators have historically often had different priorities than the executive and therefore have rarely supported their presidents in implementing radical reforms policies. A recalcitrant Congress is an obstacle against which all Brazilian Presidents have had to contend and Congressional reluctance cannot be used as a measure of political non-commitment. This is especially the case with any research into the privatisation programme in Brazil, where Congressional opposition

course of the reform, progress in the *means*—in this case privatisation—became the metric by which progress towards the *end*—ensuring sufficient electric power investment—could be measured. While the electric power privatisation programme initially proceeded according to schedule, the paper shows that when strategic tensions developed between means and ends, the government proved to be more concerned about privatising successfully rather than successful privatisation.[2] Perversely, the government began to use using state financial resources—in the form of soft loans extended to private investors by the Brazilian National Development Bank (BNDES)—in order to push privatisation. The end became privatisation, while the means used was state financial resources. Muddling progress towards the *means* with progress towards the *end*, the electric power reform programme ended up pushing the country into a severe electricity rationing.

The narrative that follows will also demonstrate that in the beginning, there was little tension between the ideas and pragmatic interests in Brazilian electric power privatisation. The strategy of privatisation served both causes: the idea of a reduced state presence in the economy as well as the interest of ensuring sufficient investment in the electric power industry. Consequently, it would appear that the Cardoso administration's privatisation strategy was driven by the more immediate pragmatic interests rather than any profound commitment to privatisation. Later, however, as the ideas pulled in one direction and the immediate pragmatic interests pulled in another, it becomes increasingly apparent that the administration's commitment to privatisation exceeded its pragmatic interests.

Within this narrative are embedded several concepts and hypotheses that have guided its preparation. Some concepts—privatisation, reform, and obsolescence—have commonly accepted definitions and since I have used them accordingly they require no further elaboration on my part. Others—means, ends, and muddling—are less common and require some clarification. Means are strategies and specific policy decisions that have been adopted in the pursuit of a well-defined goal. This goal is the end and generally there is broad consensus on its desirability, a consensus that may well be lacking for the means. Muddling refers to the displacement of the ends by the means as the driving objective of the policy process, but without the explicit recognition of this interchange on the part of the policymakers themselves. The underlying hypotheses in the paper are: (a) Muddling as a concept can only be witnessed after a certain means has obsolesced, which is to say that muddling can be ascertained if policymakers refuse to change the underlying policy even after it ceases to deliver benefits and indeed may have commenced to harm the original policy objective, and (b) the probability of the occurrence of muddling is directly related to the strength of the belief that policymakers have regarding their chosen means. The paper itself is inductive in that the narrative was developed from the observations and data that I collected during my fieldwork. The field research consisted of personal interviews with policymakers and technical staff in the Brazilian electric power industry and the collection and detailed analyses of news reports and technical literature.

---

has often paralysed both fiscal reforms and privatisation plans. Furthermore, it should be noted that the Ministry of Mines and Energy was awarded to one of Cardoso's coalition partners and was not under the direct ministerial control of Cardoso's party. However, this should not affect the analysis much because the Ministry actually had little control over the privatisation process or in setting the policy agenda. Some technical co-ordination issues and problems may have been caused by this somewhat fractured control over the ministry but I have found no evidence to indicate that it was significant.

[2]By successful privatisation I mean strengthening the financial capacity of the industry and ensuring adequate capacity expansion as opposed to privatising successfully by which I mean simply the sale of the companies for a good price.

In the following two sections, I develop these arguments by explaining explain how neo-liberal ideas came to command the global policy stage and how they penetrated the Brazilian policy arena. Then, in section IV, I explain the translation of these ideas into the Brazilian electric power industry and analyse Brazil's stubborn march to electricity rationing. In section V, I explain the policy dynamics by which means came to be muddled with ends. Section VI concludes.

2. Ideas and Interests in the Privatisation Movement

Scholarly accounts of privatisation in Latin America have tended to characterise them as pragmatic responses to fiscal crises that rendered the state weak and vulnerable to the dictates of neo-liberal ideology. These accounts buttress their claims with the undeniable fact that privatisation was generally conducted in environments of extreme fiscal predicament. Argentina's privatisation programme commenced in 1989, when the GDP had fallen by more than 6% and inflation was raging at 3,000%; Brazil's first privatisation programme was initiated after the successive oil price and interest-rate shocks that forced the government to negotiate with the International Monetary Fund (IMF) in 1982; and even in Great Britain, privatisation followed the country's fiscal woes and IMF bailout in the late 1970s. These accounts generally conclude that privatisation was usually based on short-term interests rather than on any fundamental shifts in the configuration of dominant interests, in governing ideologies or in political coalitions. Thus, Latin American governments did not privatise because they were suddenly convinced of the virtues of the market but because their fiscal shortfalls (Fishlow 1990) and debt crises (Ramamurti 1992) had become unmanageable (see also Table 1). Similarly, some scholars note that the Conservative revolution in Britain, which has often been described as the intellectual precursor for the Latin American privatisation drive, was in its inception more of a tactical response to the conservative electoral pledge to reduce taxes rather than an ideological commitment to private ownership (Feigenbaum et. al. 1998). Also highlighted is the fact that privatisation in Latin American countries such as Argentina, Bolivia, Mexico and Venezuela was initiated by traditionally populist parties that enjoyed the left's political allegiance (Murillo 2002) and hence should not be attributed to a change in governing ideology (Fishlow 1990, Vernon 1988). Others stress the role of the multilateral agencies, particularly the IMF, in leveraging their assistance with structural adjustment programmes to force privatisation (Babai 1988; Stallings 1992; Ikenberry 1990).

Although it appears that pragmatism has dominated ideas in the privatisation drive, the neo-liberal orthodoxy did have a rich intellectual tradition in criticising state ownership and control. In 1957, Anthony Downs developed the essentials of public choice theory by extending orthodox neo-classical microeconomic analysis to the political process and concluding that it is the pursuit of votes that dictates policymaking in democracies. Built on the premise that man is an egoistic, rational utility maximiser, public choice theory states that politicians and public officials pursue their individual interests over the collective good while exercising their control over state-owned enterprises. They are therefore likely to impose goals on the state owned enterprise that are politically attractive—such as maximising employment at the enterprise and keeping prices unreasonably low—but conflict with the efficiency and financial health of the public sector firm (Buchanan & Tullock 1962). Without directly contradicting the premise of market failure—which was the original reason for government involvement in various sectors of

the economy—public choice theory argued against state ownership on the grounds of the more damnable effects of government failure.[3]

The 1960s and 1970s literatures on property rights also claimed private ownership to be superior to public ownership. The neo-classical property rights school condemned communal or government ownership on the claim that dispersed ownership inevitably leads to a "tragedy of the commons" (Hardin 1968). For Alchian (1965) and Demsetz (1967), the incentives created by property rights were sufficient to explain differences in organisational behaviour: private ownership concentrates rights and rewards while public ownership dilutes them; concentrated rewards spur the owners of private firms to maximise profits and thereby efficiency while diluted rewards spawn disinterest and rent-seeking in the public sector. Agency theory claimed that the principals and agents of state owned enterprises have neither the incentives nor the tools to ensure efficient, profit-maximising performance. On the incentives side, Alchian and Demsetz's (1972) residual claimant theory argued that the existence of a specific claimant on the residual income (profit) of a private firm provides strong incentives for principals to monitor agents and control free-riders. Meanwhile, what incentives bureaucrats do face militate against efficiency in the public sector. From the organisational perspective, Niskanen (1971) explained that bureaucratic pursuit of the 3 Ps—pay, power and prestige—leads to overcapacity in state owned enterprises. As Starr (1994) succinctly and perhaps sarcastically summarised the literature, the pursuit of self interest is the source of all good in the private sector and all evil in the public sector.

Despite the rich intellectual development of the privatisation argument, most analytic approaches tend to assert that ideas played only a small and unimportant role in the neo-liberal policy decisions of the 1980s and 1990s. Given that privatisation appeared repeatedly on the policy agendas only after the various fiscal crises of the 1980s certainly appears to support the commonly received view of privatisation as a pragmatic response in the face of fiscal pressures.

Coincidence, however, cannot be used to assume causality. While privatisation did indeed appear to follow the fiscal crises of the state, a growing body of evidence is beginning to point to factors other than pragmatism in pushing the privatisation agenda forward. Empirical research in the policy arena contends that intellectual critique was important in driving the policy debates fundamental to neo-liberalism's triumphs. Several scholars (Wolfe 1991; Gamble 1989; Jenkins 1988) have asserted that the Conservatives in Great Britain were deeply influenced by neo-classical market theories and Hayek's libertarian values. Meanwhile, in the United States, Temin & Gallabos' (1987) study of long-distance telecommunications deregulation claims that ideology dominated technology in driving the policy process. And, in Latin America, we should not forget the compelling example provided by Chile and its Chicago boys which amply illustrates an ideologically committed technocratic elite dictating the economic transformation of a country through obviously neo-liberal economic policies (Sigmund 1990; Silva 1991).

Ideas were, therefore, not merely incidental bystanders to pragmatic pressures. I would, however, caution against classifying ideas and pragmatic interests into mutually exclusive domains because that risks obfuscating the symbiotic relationship that has long been acknowledged to exist between them. Weber, for example, argued that ideas were powerless in history unless they are fused with material interests. Lindblom (1965, 1977, 1990) too insisted

[3] See Schleifer (1998) for a typical government failure argument and Charles Wolf Jr. (1979, 1988), who uses public choice ideas to construct a theory of government failure that roughly parallels the theory of market failure.

that the impulse of theories and ideas must be blended with the compulsion of immediate interests in the policymaking process. In similar vein, Majone (1996) has argued that ideas and interests represent different and complementary analytic perspectives rather than mutually exclusive domains. In essence, ideas must be able to sell themselves as having the most potential to obtain successful solutions to specific problems that concern a wider population.

From this theoretical perspective, the contagious stagflation of the 1970s can be viewed as an event that provided an opportunity for already simmering neo-liberal ideas to insinuate themselves into the centre-stage of policy. Kingdon (1984) conceptualised these opportunities as policy windows and argued that policy entrepreneurs exploit these windows to grasp a problem and link it to their preferred solution. In his view, there are separate streams of problems, policies and politics and that policy windows open at discrete moments to allow these separate streams to merge into the specific policy initiatives policy entrepreneurs push. This conceptualisation appears robust in explaining how neo-liberal ideas developed in academic journals in the 1960s and 1970s were finally able to capture the wider public attention two decades later. Although the details on how to privatise had not yet been worked out, privatisation as an idea was already firmly established.

If the fiscal crises of the state were primarily responsible for prying open the policy windows to neo-liberal reforms, then parallel developments in global economic stage were responsible for pushing the windows wide open. With the progressive reduction of trade and investment barriers under the GATT/WTO frameworks, economic activities became not just internationalised but they became globalised in the sense that there was a dramatic increase in interdependence and interconnection between economic nation-states. In this globalised world, the state was considered as a container of distinctive economic institutions and practices (Talylot 1994) through its regulation of economic activities and its trade, investment and industrial policies. The government's role thus came to be redefined as that of manager of the national economy. The concept that in this globalised environment states were actually in competition with one another and that there were certain identifiable characteristics that made certain countries economically more competitive than others became popular. Although the opinions of many scholars of national competitiveness differed substantially from what would be argued by the neo-liberal orthodoxy that emerged dominant in the policy discourses in the 1980s and 1990s, the idea that states compete with one another, especially to attract investment and productive facilities, and that certain policies were superior took firm hold and stoked the popular imagination.

These certain policies came to be known popularly as the Washington Consensus, a term which John Williamson (1993, 1994) had coined to describe a set of rational economic reforms—specifically fiscal discipline, redirection of public expenditure, tax reform (lowering marginal tax rates and broadening the base), financial liberalisation, a competitive exchange rate, liberalisation of foreign direct investment (FDI) inflows, privatisation, deregulation and secure property rights—that the IMF and World Bank thought would be good for Latin America. Of these ten recommendations, the major focus of the policy reforms was, in fact, to reduce the role of government through privatisation and the liberalisation of trade, finance, and FDI entry and exit (Williamson 1999).

The staff of the Washington Consensus institutions, who perceived themselves as "storming the citadels of statism" (Kanbur 2000), argued strenuously for a vast and radical

realignment of the state (Williamson 1999), emphasising that neo-liberal policies separated the winners from the losers in the economic competition between nations. In doing so, they stressed that government's proper role was to create supportive policies for the private sector and, consequently, reforms came to be measured according to what these institutions felt was progress along these lines—privatisation, deregulation, and fiscal and monetary conservativeness. Their basic claim was a variant of institutional isomorphism (see DiMaggio & Powell 1983) at the level of the nation-state and argued that less successful nations ought to copy the habits of successful ones and make themselves over in the latter's image. And indeed, as we shall see later, this isomorphism was as much about providing legitimacy for certain reform initiatives than improving performance.

In this process, market fundamentalism came to dominate the politico-economic dialogue as studies, some of questionable empirical accuracy, advocated a drastic reduction of the state. In *The East Asian Miracle*, for example, the World Bank (1993) proffered a set of orthodox economic policies—financial and trade liberalisation amongst others—as the fundamental basis for explaining the economic success of the Asian Tigers. East Asian scholars immediately repudiated the study for factual distortion claiming that the South Korean and Taiwanese governments had, in fact, followed a heterodox set of policies, directing credit to privileged industries rather than allowing the market to determine the allocation of credit, consistently manipulating their exchange rates as part of their industrial policy and actively and extensively using and non- barriers to protect and promote strategic domestic industries (Amsden 1994, Perkins 1994).

Despite these analytic challenges, the advocates of neo-liberalism were largely successful in popularising their views on privatisation, deregulation and trade liberalisation. Although Williamson (1999) would later claim that he intended the term Washington Consensus to refer to the intellectual convergence that underlined the development of the policy recommendations rather than to the liberalising reforms programmes imposed by the IMF and World Bank or to economic restructuring as it was actually practised in Latin America, Williamson's need to defend his own term clearly indicates the extent to which the neo-liberal agenda had come to dominate policymaking in that period. In the popular press and in the policy arenas that counted, neo-liberalism and market fundamentalism was what became the primary policy driver. The policy windows to a well-defined set of policy reforms were thus flung open.

3. The Windows for Economic Modernisation in Brazil

The previous section explained the process by which discontinuous change in the global economic environment opened windows of opportunity for what Krugman (1995) called the Victorian virtues in economic policy—sound money and free markets—to take hold. Sound money was, of course, something that governments could strive for autonomously; trade liberalisation was more a bilateral and multilateral negotiation game subject to a different rhythm. In this section, I explain how the successive macroeconomic crises of the 1980s led to the rejection of Brazil's entrepreneurial state and the adoption of an economic modernisation programme based on the Victorian virtues. These crises led to the subordination of industrial policy to orthodox monetarism and to the reduction of the state's role in the economy through privatisation.

Import substitution and a strong state-led industrialisation strategy had characterised the Brazilian economy from the 1950s onwards. These strategies were based on the Gerschenkronian thesis that as a late starter to industrialisation, Brazil, like other developing countries, needed an entrepreneurial and interventionist state to overcome underdeveloped and imperfect domestic markets. An entrepreneurial state was an expression of both an economic nationalism and a developmental ideology. It intended to accelerate and internalise technological learning in order to create a robust and diversified domestic industrial base. Brazil's strategies based on state entrepreneurship were not novel but part of a well-established trend in Latin America (Hirshman 1968; Evans 1979)[4] as well as in Asia (see, for example, the case of the model government factories in Japan).

Epitomised by Vargas' *Estado Novo*, Kubitschek's "50 years in 5" and rigourously applied even by the later nominally right-wing military governments, the entrepreneurial state in Brazil was generally based not on nationalisation via the expropriation of foreign-owned assets but on heavy state investment in "empty spaces" in the economy—in areas such as minerals and mining—where private investors had failed to make inroads. In areas where the state did nationalise—electric power and telecommunications, for example—it did so only after the private sector had proved unwilling and/or unable to invest sufficiently (Trebat 1983). State intervention was, therefore, not a first choice but rather the result of the private sector inability or unwillingness to invest. Of course, it can be argued that one of the main reasons the private sector stopped investing heavily in industries like electric power was the constant threat of government rate controls. For a long time, the entrepreneurial state yielded strong and sustained economic growth in Brazil (see Chart 2). But, because foreign finance played a crucial role in the Brazilian industrialisation effort, this growth came at the cost of a high internal and especially external debt (see Table 2 and Chart 3).

State-owned firms played an important part in both Brazil's industrialisation and in the country's economic stabilisation efforts. They led in the creation of basic infrastructure and the development of heavy manufacturing, often gaining a reputation for efficiency and technological leadership.[5] However, during times of economic stress, the Brazilian government frequently forced them to borrow excessively in international markets while at the same time restraining the prices they could charge, first to promote industrialisation and then in an effort to combat inflation. This strategy was initially successful in promoting economic growth but its internal contradictions—of low prices and returns while trying to increase investment—made it unsustainable after the macroeconomic shocks in the 1970s and 1980s. Squeezed between un-remunerative prices and excessive debt, Brazilian state owned firms came to be blamed for both their own financial insolvency and for Brazil's deficit problem. On the balance, therefore, Brazilian state-owned firms were technically capable but frequently suffered abusive financial policies at the hands of the government. Continuing economic stresses made their continuing exploitation untenable and thus opened the policy windows to neo-liberal reform in Brazil.

[4] See also, for example, the work of Raul Prebisch and the Economic Commission for Latin America (1950) on dependent development).

[5] State owned firms such as USIMINAS and Embraer, both subsequently privatised, were acknowledged leaders in their fields. Other state owned firms, such as Cemig and Copel, still not privatised, are also considered both technologically and operationally efficient.

3.1. Opening the Policy Window to Privatisation in Brazil[6]

In Brazil, as in many other countries, the window to orthodox reform and privatisation was unlatched by the external economic shocks of the 1970s and 1980s. The first shock was the explosion of oil prices in November 1973, which resulted in Brazil's current account deficit ballooning from US$ 1.7 billion in 1973 to US$ 7.1 billion in 1975. At that time, the Geisel administration, gambling that it could pay Brazil's rapidly rising oil bill by growing even faster, advocated a policy of growth via debt. Geisel's National Development Plan therefore implemented a massive debt-based investment programme in basic industries such as metals, fertilisers and petrochemicals and in infrastructure such as energy, communications, and transportation (Baer 2001). As a result, net external debt[7] grew at an average annual rate of almost 40%, increasing from US$ 6.2 billion to US$ 31.6 billion between 1973 and 1978. In 1979, Brazil suffered a second shock when oil prices doubled and, simultaneously, tight monetary policy in the United States triggered a large increase in international interest rates. Both had predictable consequences on Brazil's debt and fiscal balances. In response, the government announced major changes in economic policy and a series of austerity measures that included devaluation, cuts in public spending, elimination of many subsidies and tax incentives, limits on credit expansion and on imports, and reductions of incentives for export. Partly as a result of these policies, stagflation hit the Brazilian economy the following year. The third shock came in 1982 when international finance markets shut out Latin American borrowing following Mexico's debt moratorium. External debt service was already absorbing 83% of Brazil's export earnings. Unable to rollover its debt, Brazil was forced into structural adjustment programmes even more painful than the ones it had already adopted in response to the first two shocks. Initially Brazilian authorities tried to weather the storm without resorting to IMF assistance but in November 1982, after the parliamentary and gubernatorial elections, the government began to negotiate a US$ 4.8 billion IMF loan to pay the interest on its external debt. The following January Brazil delivered the first of a series of letters of intent to the IMF promising various austerity measures including a drastic reduction in public investments. Brazilian economic growth slowed in response, but the external debt continued to rise and was accompanied by extremely high inflation. Between 1982 and 1987, external debt almost doubled, increasing from US$ 48 billion to US$ 91 billion, and inflation raged at over 1000% a year.

These shocks and the ineffectiveness of the government's response transformed Brazil's economic and political landscape. First, the intractability of the Brazilian economic problems in the 1980s made the idea of the entrepreneurial state obsolete. Second, the military government, unable to pull Brazil out of its unrelenting stagflation in the 1980s, lost the support of the industrial classes and was ousted from power in 1985. With Brazil's subsequent re-democratisation, the policy windows opened for an economic modernisation project that would attempt to reduce the scope and role of the state in the domestic economy.

As a direct result of the economic instability, Brazil's entrepreneurial state lost credibility and became vulnerable to new ideas. These new ideas, fundamentally neo-liberal in character,

[6] This section borrows heavily from Baer (2001).
[7] Net external debt = external debt – foreign exchange reserves.

were articulated politically by Fernando Collor who was elected President in 1990.[8] His administration intended to represent a clean, clear and fundamental break from Brazil's historically entrepreneurial state. Having campaigned on a modernist platform of fiscal discipline, privatisation and economic liberalisation, Collor initiated ambitious attempts to dismantle the Brazilian state and transfer the responsibility of economic development to the private sector, promising privatisation and liberalisation as incentives. He included these reforms in a letter of intent sent to the IMF in January 1992 in which he also offered a tight credit policy to reduce inflation. In exchange Collor wanted a US$ 2.1 billion standby loan and eventually a restructuring of credit with commercial banks as part of the Brady Plan[9].

It was not external agents, however, who pushed Collor towards privatisation. Criticising what he characterised as an overblown entrepreneurial state responsible for most of Brazil's economic ills, Collor himself had introduced the National Privatisation Programme (PND) in 1990 (two years before sending his letter of intent to the IMF) as part of a comprehensive government effort to introduce market reforms. The PND was ambitious, stating that its objectives were to strategically reorient the state, reduce the public debt, reinitiate private sector investment, modernise industry and strengthen domestic capital markets.[10] A modest privatisation effort, one which was clearly pragmatic in character, had already been initiated in the previous decade when the National Economic and Social Development Bank (BNDES) had begun to re-privatise the bankrupt firms it had taken over during the 1974-82 economic crises.[11] The PND, on the other hand, was a much more comprehensive programme that targeted traditionally state-owned firms, such as large mineral and mining enterprises. As opposed to the individual enterprise privatisations conducted in the 1980s, PND pursued privatisation on a sectoral basis, focusing on the heavy industrial sectors—mining, petrochemicals, and fertilisers.

---

[8]Brazil's first civilian administration was handicapped by the death of the president-elect, Tancredo Neves before he could even be sworn-in. His Vice, Jose Sarney, from the Liberal Front (a dissident faction of a party that had till recently aligned itself with the military government), did not introduce any major reforms because he enjoyed little popular support and remained politically handicapped throughout his tenure. The Sarney administration's economic policy could be described best as indecisive, during which Brazil suffered through three different finance ministers and an equal number of economic stabilisation plans, none of which was successful in controlling inflation.

[9]Developed by US Treasury Secretary Nicholas Brady in 1989, the Brady Plan was a debt relief and rescheduling programme that was extended to deeply indebted countries that would commit to pursuing orthodox economic reform programmes. It allowed such countries to restructure their existing commercial bank debt by reducing either the face value of the debt or the interest rate payable on it. To encourage the commercial banks which held such debt to voluntarily participate in the programme, the IMF and World Bank either provided collateral on the reduced value of the debt or awarded debtor governments loans to repurchase their debts directly. In this manner, the Brady Plan allowed many developing countries to reduce their debt and debt service burdens and to regain access to international capital markets.

[10]Foreign investors were restricted to 40% of the voting capital (unless expressly authorised to the contrary by Congress). Furthermore, foreigners were restricted from acquiring a majority stake in PND companies for a period of two to three years after privatisation. Foreign capital also could not be repatriated for at least six years following the initial investment. This period was originally set at 12 years but was modified given the lack of foreign investor interest. In any case, in the initial privatisations, foreigners acquired only 5% of the assets sold, most of it using domestic debt instruments (Pinhero & Giambiagi 1994).

[11] During the economic crises, the Brazilian National Development Bank (BNDES) had lent substantial sums of money to private firms to ensure their survival through the turbulence. However, as the crisis became prolonged the firms remained unable to service their debt. BNDES then converted its credits into capital and assumed shareholder control. It was these traditionally private firms that were the first targets of privatisation and the objective at that time was simply to clean up BNDES' portfolio. The programme was rather modest, with only one company that was worth over $100 million being privatised. However, one of the more significant consequences of the first phase of privatisation was that as a result of the experience that it gained through the process, BNDES was put in charge of the subsequent privatisation efforts.

This second phase of privatisation also marked the sale of efficient and profitable state-owned enterprises, such as USIMINAS, which alone fetched twice as much as all the privatisations in the 1980s. Collor also intended to privatise public utilities, but since the 1988 Brazilian Constitution prohibited private provision of infrastructure services, Collor had to lay the legal groundwork first.

Collor was, thus, not at all reluctant to privatise. He was, in fact, rather keen to accelerate privatisation. His policies were similar to the ones Argentina and Mexico were pursuing, all of which were, in fact, in competition with each other to secure foreign investment. Not surprisingly, the agreements and reforms pleased the Finance Minister, Marcílio Marques Moreira, who predicted that Brazil would receive over US$ 20 billion in foreign capital in 1991, doubling and quadrupling the amounts received in the previous two years respectively. The subtext was, of course, that in the competition for international investor interest in the region, Brazil would attract funds away from Argentina and Mexico. In terms of institutional isomorphism, the process was nearing completion, with the major Latin American economies all following the same basic economic prescriptions.

3.2. Propping Open the Windows

The Collor administration was optimistic and had hoped both for quick sales of the state-owned enterprises (SOEs) and to expand the privatisation programme into the infrastructure sectors. Both, however, proved unattainable. It took several months to prepare each SOE for privatisation and the administration's attempt to expand the privatisation programme ended with Collar's impeachment on charges of corruption in public procurement schemes.

Collor's Vice-President, Itamar Franco took over in October 1992 for the rest of the term. Franco was not known to be a moderniser nor was he known to be sympathetic to private capital and he initially resisted further privatisation. With the failure of Collor's economic stabilisation plans, Brazil continued to suffer high inflation rates, operational deficits and a stagnant economy. In 1992, the monthly inflation rate varied between 25% and 30%, the operational deficit hovered around 2.5% of GDP and the real GDP declined about 1%. With these problems continuing to plague his economic team, Franco went through three finance ministers, at the rate of about one every two months, before finally appointing Senator Fernando Henrique Cardoso to the post in May 1993.

When Cardoso took over as Finance Minister, it was popularly believed that the high levels of fiscal deficits at all levels of government were the fundamental weakness in the Brazilian economy and the critical cause of the failure of the economic stabilisation efforts of the military as well as the democratic administrations. According to this view, articulated by Baer (2001) Brazil was trapped in a vicious cycle of chronic deficits, inflation and high interest rates, where market scepticism about Brazil's ability to service its debt forced the government into ever shortening terms of financing, at times even in the overnight market at very high interest rates. These rates increased the burden of debt service even more and further worsened Brazil's fiscal balance and, predictably, the worsening fiscal deficits forced the government to offer ever-higher interest rates. Fiscal indiscipline was believed to be at the root of the problem because the government, forced to rely on financial markets to finance its deficit, was unable to break out of this vicious cycle.

Cardoso's policy initiatives reflected the belief that fiscal indiscipline was at the root of Brazil's economic troubles and that much of the blame for Brazil's fiscal problems rested with the state governments. Determined to impose fiscal discipline, he began with an Immediate Action Plan (IAP) to cut federal, state and local government spending by US$ 6 billion. Simultaneously, he pressured state governments to clear up their debts to the federal government, threatening to withhold federal guarantees for state borrowing unless they voluntarily set aside at least 9% of their budgets to pay off their debts to the federal government. Cardoso also tried to control tax evasion, which was estimated to cost the federal government between $40 and $60 billion annually (Baer 2001). The initial efforts were only slightly successful: there was some economic growth during this period but inflation remained high, exceeding 30% per month

In February 1994, Cardoso introduced his Real Plan. The Real Plan did not repeat the previously failed strategies of price freezes and indexation but, instead, like the Argentine Law of Convertibility pegged the local currency to the US dollar.[12] First, the administration created an index, the Unit of Real Value (Unidade Real de Valor—URV), which it pegged one-to-one with the US dollar. According to the prevailing inflation rate, the URV's quotation in Cruzeiros (the local currency) rose daily, accompanying the exchange rate. The government denominated official prices, contracts and taxes in the URV and the private sector to use it too. As this system quickly became popular, the government introduced the new currency based on this indexer, the Real, in July 1994.

Cardoso's aim was to get the federal budget to balance. The currency peg was therefore accompanied by an austerity programme. The Real Plan increased taxes, cut federal spending on investments, personnel and state owned enterprises, and transferred to state and local governments the responsibilities for health, education, social services, housing, basic sanitation, and irrigation.[13]

The Real Plan was at least the sixth major plan for stabilising the Brazilian economy since 1985, but unlike the previous plans, it actually worked. Inflation fell from a monthly rate that exceeded 50% to less than 1% between June and September 1994. Economic stability helped stimulate demand and industrial production, which led to growth rates exceeding 5% in the latter half of 1994.

Brazil's currency peg overvalued the domestic currency. This, in concert with trade liberalisation, was crucial in beating inflation. Between 1990 and 1994, Brazil had reduced average s from 32.2% to 14.2%. As a result of this trade openness, domestic producers were constrained in raising prices because the overvalued Real facilitated price competition from imports. An overvalued exchange rate was also important to manage the debt since any currency devaluation would increase the domestic value of the foreign debt.

Initial success with the Real Plan propelled Cardoso to the Presidency in 1995. However, the high interest rates set by the monetary authorities, necessary to maintain the currency peg and control inflation, were causing severe economic problems. As it was, the overvalued Real led to a fall in exports and a rise in imports. In 1995, Brazil's trade balance became negative for the

[12]Unlike the Argentine Law of Convertibility, the Brazilian Real was not legally required to be pegged to the dollar.
[13] This last measure reversed some of the negative effects of the 1988 Constitution, which had worsened federal budgetary deficits by mandating the transfer of 21.5% of taxes on income and manufactured goods to state and municipal governments without reducing federal government responsibilities in any significant manner.

first time in a decade (Table 3). In addition, the high interest rates were slowing economic growth and pushing up Brazil's debt service payments.

It was at this stage that the privatisation of Brazilian public utilities took off, mainly because Cardoso's high voter approval rating—he had won easily in the first round of the Presidential elections—meant that he could get the legislation necessary to privatise public utilities passed rapidly through Congress.

Privatisation served Cardoso's major policy objectives in three ways. First, privatisation would provide immediate funds to help pay for a one-time reduction in the federal debt. Second, privatisation would help prop up the value of the Real during Brazil's transition to fiscal balance. Third, privatisation would fiscally discipline the federal and, more importantly, state governments by eliminating the institutional structures that had facilitated fiscal indiscipline.

Cardoso was especially concerned about this last issue. By 1993, the various state governments had racked up US$ 36 billion in debt to the federal government and of this US$ 2 billion were in arrears. Furthermore, many of these governments had excessively borrowed from the banks that they owned and had driven them to illiquidity. This, in turn, fuelled inflation because it pressured the Central Bank to issue more money in order to keep the state banks afloat (Baer 2001).

It was also believed that state governments were using their power distribution companies to extract resources from the federal government, especially after the latter intervened to prevent unrestrained borrowing from state banks. Power distribution companies in Brazil generally received bulk power supplies from federally-owned generation companies. In the early 1990s, many state governments stopped paying the generation companies for the bulk power supplies. As the federal government could hardly cut off power to entire cities and states, there was effectively no way of addressing this fiscal indiscipline (Giambiagi & Além 2001). However, distribution companies felt justified in withholding payments to the federal generation companies because, they argued, federal electric power policies had unfairly limited their revenues and restricted them to a rate of return far below the 10% that was guaranteed by the 1934 Water Code,

Thus, the privatisation of public utilities, in addition to being a goal to be pursued for its own sake, served several strategic purposes. The administration expected Brazil's massive electric power sector and the telecommunications firms to fetch tens of billions of dollars and believed that this influx of this foreign exchange would increase demand for the Real and keep its value stable. The resulting monetary stability itself would reinforce investor confidence and demand and push privatisation prices even higher. Privatisation and the Real Plan were thus symbiotic.

3.3. The Windows Shut Again

Back in the 1980s, globally contagious financial crises opened up the policy windows to neo-liberal economic modernisation in Brazil. In the late 1990s, it was again contagious financial crises that closed the policy window to Cardoso's modernisation programme and led eventually to the electoral repudiation of his policies.

Cardoso's Real Plan ended Brazil's chronic inflation problem (see Table 4) but the long-term success of the plan was always hostage to foreign investor enthusiasm. As long as the dollars flowed in, the currency peg could be maintained. In the end, the Asian financial crisis in 1997 followed by the Russian debt moratorium in 1998 exposed the intrinsic fragility and the internal contradictions in Brazil's monetary orthodoxy. Facing capital flight, the Central Bank dramatically increased interest rates to maintain the currency peg but this exerted even greater pressure on the operational deficit, whose value increased 8.4% in 1998. International investors whose net portfolio investments had been financing the mounting current account deficit began to withdraw their funds in larger quantities, expecting, correctly, that the Central Bank would not be able to defend the overvalued Real for much longer. Speculative attacks on the Real served to make an already bad situation worse. The Central Bank, wanting to maintain the peg and monetary openness, doubled interest rates but failed to control capital flight. Foreign exchange reserves were halved, from US$ 75 billion in August 1998 to less than US$ 35 billion in January 1999. In November 1998, the IMF, World Bank and the US government put together a US$ 41.5 billion package to defend the Real and demanded, in exchange, strict controls on government spending and tough limitations on public sector borrowing requirements (PSBR).

Although high interest rates and the overvalued Real were weakening the fundamentals of the Brazilian economy, there was great resistance to timely devaluation because Cardoso, who had already stated that devaluation would be a political and economic disaster, was unwilling to entertain any changes in the Real's value before he secured his re-election.

His second term, consequently, began chaotically. Less than a week after the inauguration—on 1st January 1999—the new Governor of Minas Gerais, Itamar Franco, the man who as President had appointed Cardoso as finance minister back in 1994, declared a 90-day moratorium on his state's US$ 15 billion debt payments to the federal government. Franco's rebellion was joined by the governors of Rio Grande do Sul and Rio de Janeiro. Together, Brazil's 27 states owed the federal government over US$ 100 billion and the prospect of more governors joining the rebellion put enormous pressure on the treasury. Within the week, Central Bank President resigned and his replacement allowed the Real to devalue immediately 8% against the dollar by widening the currency trading band. However, attempts to maintain pegged exchange rates with high interest rates and external financial support rarely work and Brazil was unable to stem the outflow of capital. In addition, the high interest rates were producing a massive economic recession. Eventually, Cardoso yielded and allowed the exchange rate to float freely. Over the next two months the Brazilian currency devalued 40% but despite Cardoso's earlier dire prediction, the devaluation was not an economic disaster and inflation did not remerge as a problem.

Paradoxically, Cardoso, the champion of fiscal orthodoxy ended up through his policies presiding over a sustained increase in Brazil's public sector debt. In fact, public sector debt as a percentage of GDP had been falling steadily since 1984 and it was the Real Plan that reversed this trend in 1994 (see Chart 3). Debt rose partly because Cardoso failed to secure fundamental fiscal reforms, which led to worsening operational deficits (see Table 5). To ensure that the deficits did not push inflation, his administration did not finance the deficit by borrowing from the Central Bank. Instead, Brazil borrowed heavily on domestic and international credit markets. Even while the economy was stable and growing, the Brazilian monetary authorities had to offer very high interest rates in order to maintain the Real's overvalued rates and to finance the public sector deficits in a non-inflationary manner. In doing so, Brazil again fell into a vicious circle of

high interest rate payments that worsened the federal deficit and forced the government into offering even higher interest rates in order to finance the increasing deficits. The benchmark rate generally hovered around 30% and, at times, short term interest rates on Brazil's debt approached the 50% mark. Indeed, investors generally recognised that the Real was significantly overvalued and were demanding high interest rates mostly to compensate for the risk of devaluation. As a result, although Brazil had been running a primary budget surplus, interest payments led public sector debt to increase from 35% of GDP at the beginning of 1998 to over 50% of GDP a year later. In 1998 alone, the government paid US$ 49 billion in interest.

During this period, public utility privatisation had come to be regarded as synonymous with the Real Plan, both for their symbiotic relationship and because of privatisation's high public profile. The economic turmoil of 1998 and 1999 consequently weakened popular and political support for both. Cardoso's second term witnessed his administration floundering, unable to pursue privatisation to what they believed was its logical conclusion.

Public utility privatisation generally failed to deliver on its desired and expected benefits. It did not much help Brazil's public debt problem. Despite receiving over US$ 90 billion from privatisation between 1991 and 1999, Brazil's foreign debt actually increased by 77% over this period. It did help prop up the Real, but only temporarily. In any case, there was only a finite amount of assets that could be sold. It did bring in foreign and private investment, but not enough to make a permanent impact on the Brazilian federal finances. The proverbial last straw was when serious mistakes in the privatisation of the electric power industry led to a severe electricity rationing in 2001. In 2002, the election of the Workers Party's Lula da Silva as President slammed shut the window to further privatisation in Brazil.

4. Electric Power Reform Between the Policy Windows

The previous section explained how the policy windows to an orthodox reforms programme opened as a result of the Brazilian military government's failure to provide economic stability and growth in the early 1980s and then how the policy windows jammed with the vicissitudes of the Real Plan. Paralleling developments in the Brazilian economy, the policy windows to privatisation in the electric power industry opened, and shut, more or less in concert with the political fortunes of the reformers. In this section, I analyse how electric power privatisation was conducted between the policy windows.

4.1. Origins of the Crisis in the Brazilian Electric Power Industry

The crisis that Brazil's electric power industry was facing in the early 1990s traces back to the federal government's policy responses to the economic turmoil of the 1970s and 1980s. Until the early 1970s, the electric power industry enjoyed access to low-cost investment funds as well as rates that were sufficient to remunerate both capital and operational costs. From 1974, however, the federal government, in response to the macroeconomic problems of the 1970s and 1980s and as part of their economic development strategy, began to implement a series of policies that distorted the economics of the industry.

First, the government equalised electricity rates throughout the country as part of an effort to promote geographical depth in industrial development. Because the 1934 Water Code under which electric power companies were regulated had established minimum and maximum

limits on the rate of return at 10% and 12% respectively, this meant that power firms with lower costs of production stood to make more than a 10% return on assets while those with higher costs stood to make less. To resolve this distortion, the government created a General Guarantee Reserve (*Reserva Geral de Garantia* or RGG) and Results Compensation Account (*Conta de Resutados a Compensar* or CRC) the following year. Firms with returns less than 10% return would have their accounts credited in amount of the shortfall in revenue and firms with returns over 12% would have their accounts debited in the amount of their excess revenues. Predictably, this reduced incentives for both credited and debited firms to be cost efficient.

More serious, however, was that after 1977 the federal government began to limit increases in electricity rates as a means to combat inflation. As a result, the return on assets of electric power companies in general fell to about 4% as opposed to the 10% that was legally guaranteed by the 1934 Water Code (Gomes, et.al. undated). Compounding the problem of inadequate rates, the federal government also began to force state-owned enterprises (SOEs)—especially power and steel companies—to borrow abroad in order to obtain the foreign exchange that the government needed to finance its balance of payments deficits and to roll over its debt. Thus, the government's policy of suppressing electricity rates not only reduced inflation pressures but also was useful in persuading power firms to borrow overseas. Eroded by inflation, electricity rates lost a third of their real value between 1974 and 1984 (see Table 9) and power companies became increasingly dependent on foreign loans for investment (see Table 8). As a result, resources began to be diverted from the power sector. Whereas in 1970 over 78% of the financial resources in the industry had gone towards investment, by 1989 over 74% of these resources went solely to debt service (Oliveira 1997). Perversely, it was no longer the infrastructure needs of the country that motivated public firms to take out foreign loans but the necessity to roll over the debt that created the projects. Adding to the injury, the government often diverted funds from these loans so that state-owned enterprises racked up debt yet developed no corresponding physical assets.

Price controls thus began a process of de-capitalisation in the electric power industry but because of the guaranteed remuneration clause of the 1934 Water Code, it was the federal government that became responsible for the accumulated deficits in the CRC. These deficits would eventually add up to US$ 26 billion. In 1986, frustrated with federally imposed rate controls, the government of São Paulo formally refused to contribute to the CRC and even instructed its power company to stop making payments to the federal generating companies. Given that President Sarney failed to take strong action against São Paulo, this strategy was followed soon thereafter by other state governments. The intricate balancing system that the military government had developed was beginning to unravel. By the end of the decade, the electric power industry was saddled with high debt, handicapped with inadequate revenues, plagued by insufficient investment capability and threatened with power shortages.

The popular view at that time was that state ownership was obviously to blame for this sorry state of affairs. Price distortions, unnecessary and inefficient investment projects and the progressively debilitated the finances of the sector were all blamed on political interference in internal management of the power firms. The system was definitely broken and this unlatched the window to the proposed privatisation of the Brazilian electric power system.

4.2. Laying the Legal Groundwork

Although electric power privatisation occurred exclusively under the Cardoso administration, it was actually Collor who had first initiated attempts to privatise Brazil's public utilities. Collor was unable to make much headway in privatising electric power firms because the Brazilian constitution did not permit the privatisation of infrastructure services such as electric power, telecommunications, and water & sanitation. He did, however, begin the legal groundwork to privatising and liberalising the electric power industry and it was in fact under his administration that Escelsa and Rio Light (the first two electric power companies to be privatized, in 1995 and 1996 respectively) were entered into the National Privatisation Programme (PND) in 1992.

The fundamental reforms of the Brazilian electric power industry were legally enacted under Collor's successor, Itamar Franco. In 1993, the Brazilian Congress passed critical pieces of legislation that paved the way for the financial recovery of the electric power industry. Law 8,643/93 (Disequalisation Law) eliminated the uniform national power rate and allowed power companies to charge customers rates that reflected both the cost of generation and an adequate return on capital investments. The law also did away with the legally guaranteed but rarely honoured 10% rate of return that had been established by the 1934 Water Code and, consequently, with the CRC. Most importantly for privatisation, Law 8,631/93 sanitised the finances of the electric power sector by having the Treasury assume the US$ 26 billion hole that had developed in the CRC. Resolution 1,063/93 initiated market liberalisation by introducing more flexible energy rates to large, energy-intensive customers and allowing utilities to negotiate rates with directly with different customers. Decree 1009/93, which created the national electricity transmission system (SINTREL), enabled free access to the federal transmission network thereby facilitating, theoretically and legally, competition in the generation sector. These laws collectively laid the foundation to modernising the institutional relationships in the power sector. Franco, however, made no effort to privatise the electric power companies or to really increase power rates.

Having defeated inflation and established a stable currency with the Real Plan, it was Cardoso who had both the desire and the political capital to push through the constitutional amendments and the new laws required to privatise and liberalise Brazil's state-owned and monopolistic electric power sector. In his first year in office, Congress passed the *Concessions Law* (Law 8,987/95), which opened public utility services to competitive public auctions[14] and Law 9,074/95 (complemented by Ministerial Decree 203/96), which established the procedures for conducting public bidding and the designation of independent power producers to supply power to free consumers.[15] With the legal groundwork laid, the windows to electric power privatisation were finally opened and the Cardoso administration proceeded to privatise in a hurry.

---

[14] Concessions were for 30 years in the case of distribution and transmission companies and 35 years for generation companies.

[15] The Law defined free customers as those who consume more than 10 MW and are supplied at a tension equal to or higher than 69 kV. These customers were allowed to purchase power from IPPs immediately and after a period of five years from any power producer—concessionaire or independent. New consumers with requirements over 3 MW were also allowed immediate freedom of choice; existing customers whose requirements were between 3MW and 10 MW would have to wait till 2000 to exercise freedom of choice.

4.3. Electric Power Privatisation

When the Cardoso administration began to privatise electric power in 1995, the industry consisted of mainly three types of firms. First were the four large federally-owned generation and transmission companies (GENCOS)—Furnas, Chesf, Eletrosul and Eletronorte supplying the Southeast and Centre-West (SE/CW), Northeast (NE), South (S) and North (N) zones of the country respectively. These GENCOS were placed under Eletrobras, a holding company established by the federal government in 1962. In addition, Eletrobras had three other responsibilities—planning the expansion of electric power infrastructure, lending to electric power projects and co-ordinating the dispatch of electricity from the various power plants in a centralised manner. Second were electricity distribution companies (DISCOS) in each of Brazil's 26 states which were generally owned by their respective state governments. Third were the vertically integrated power companies that combined generation, transmission and distribution functions. These firms were owned by the governments of the wealthier industrialised states of São Paulo (Cesp), Minas Gerais (Cemig), Parana (Copel) and Rio Grande do Sul (CEEE).

Although it was the power generation sector that was most starved for investment and although it would have been easier to introduce competition in the generation sector first, Cardoso's distrust in state governments' fiscal attitudes led the administration to privatise DISCOS first. They reasoned that since DISCOS had been delinquent in their payments to GENCOS, it would have been difficult to persuade private investment in power generation without federal guarantees backing DISCOS' payments to privatised GENCOS. With the Treasury having already assumed US$ 26 billion of cross-debt in the industry, the administration did not want to provide any more guarantees to the sector and was very keen to ensure that the revenue stream in the sector—from customer to DISCO to GENCO—be stable and secure. The administration expected privatised DISCOS to be more vigorous in collecting bills and in honouring their payment obligations to GENCOS.

There was another logical reason for beginning the privatisation process with DISCOS. Brazil's power generation infrastructure was for the most part based on large multi-purpose hydroelectric dams. As such, the rules for the proposed wholesale market as well as regulation and charges for water-use were complex issues which would require time to analyse and construct. They would also require the establishment of a new and independent electric power regulatory authority and, preferably, also an independent water regulatory authority. The administration, wanting to commence privatisation immediately, reasoned that while the DISCOS were being privatised, the market rules and necessary regulatory agencies could be created. The electric power sector still lacked its independent regulatory agency, but the administration decided that the terms of service could be written into the DISCOS' concessions contracts and would suffice until such time as the new independent electric power regulatory agency could be established.[16]

Since it was the state governments that owned most of the DISCOS, the administration needed a tool to persuade them to relinquish control. To do so, the BNDES created the State-level Privatisation Stimulation Programme (Programa de Estímulo ás Privatizações Estaduais – PEPE). In August 1996 the BNDES Board of Directors established procedures to anticipate funds to state governments on the basis of future privatisations. After an initial valuation of the

[16]Nominally, the National Department of Water and Electricity (DNAEE) was in charge of regulating the sector but the agency was rather moribund.

DISCO by a BNDES team, the state government was required to put up the shares of the DISCO as security in order to receive a loan (at TJLP—the basic long term interest rate—plus 8%) of equivalent value on the understanding that the shares would later be auctioned. The difference between the value estimated by BNDES and the actual sale price—known as upside—would be shared with 80% going to the state government and 20% to BNDES. To ensure that the privatisation would actually go through, states were given a period of one year to carry out the auctions, failing which BNDES' share in the upside would rise, interest rates on the original loan would increase and BNDES would be allowed to go ahead and auction the DISCO on its own. BNDES generally under-priced the shares initially as an additional means of persuading states to actually sell the shares since they would stand to make more than the loans they had been given. It can also be argued that by lowering the initial estimate, BNDES inflated the value of the upside and consequently its own earnings from the transaction and, therefore, had a vested interest in both keeping the initial value low and later, during the privatisation process, pressing for maximising the eventual sale price.

Indeed, revenues from the DISCO privatisation programme generally exceeded expectations, bringing in over US$ 20 billion. Although the total revenue from telecommunications privatisations exceeded slightly the revenue earned from electricity privatisation (see Chart 4), the largest federal GENCOS—Furnas and Chesf—and the large vertically integrated state-owned power companies—Cemig and Copel—had yet to be privatised. As a result of this frantic pace of selling Brazil, which before 1995 had privatised little, became the largest recipient of privatisation revenues in Latin America. The first two DISCOS to be privatised—Escelsa and Rio Light—were actually controlled by Eletrobras and not by their respective state governments. Escelsa was privatised in June 1995 followed about a year afterwards by Rio Light. Light sold for US$ 2.3 billion, which was at the time one of the largest single privatisations in Latin America. A few weeks later, on 20th November 1996, CERJ became the first state government owned DISCO to be privatised. By late 1997 almost all the major DISCOS had been privatised, fetching handsome premiums over their minimum reserve prices (see Table 10). In fact, on a per-MW basis, Brazilian DISCOS generally commanded a much higher price than DISCOS in other Latin American countries.

Privatisation of Brazil's generation capacity proceeded much less spectacularly. It was not until May 1998, almost three years after DISCO privatisation had commenced, that the Brazilian Congress passed the legislation enabling generation company privatisation. Law 9,648/98 established the guidelines to privatise the federal GENCOS, proposing to split Furnas and Chesf into two generation and one transmission company each, Eletrosul into one generation and one transmission company, and Eletronorte into six different firms. The law creating a national water regulatory agency (ANA), which was important to privatising GENCOS given that over 90% of Brazil's installed capacity was at the time hydro-based, took even longer. ANA was finally established only in December 2000 after Congress passed Law 9,984/00 in June 2000.

Eletrosul's generation arm, Gerasul, was the first generation company to be privatised. It was auctioned in September 1998, but there was only one bidder—Belgium's Tractabel—who won the concession after bidding only the minimum reserve price. In the meantime, the state governments of São Paulo and Parana began to prepare their own vertically integrated firms for privatisation. São Paulo had already divided its massive CESP into six different firms—three

each in distribution and generation. The distribution firms were all auctioned off in 1998. Two of the three generation firms—CESP-Parapanema and CESP-Tiete—were auctioned off in 1999.

Privatising the remaining generation infrastructure proved to be much more complicated. The auction of CESP-Parana was delayed because of construction delays in its Porto Primavera hydroelectric plant and questions about environmental issues that could potentially delay the filling of its reservoir. Furnas's privatisation proved to be even more complex. First, Furnas' nuclear assets had to be separated from the company because Brazilian law did not permit private ownership of nuclear plants. Second, the company's multi-billion reais debt to its employees' pension fund needed to be sorted out. Finally, many industry experts, Furnas employees and politicians were opposed to either to its dismemberment or to its privatisation or to both. Chesf privatisation was opposed by the politicians of the Northeast who viewed the company more as a development agency than as merely an electric power generator. Eletronorte's privatisation was similarly delayed because the state-level politicians were demanding guarantees that the proceeds from the firm's sale would be used to develop the region's power infrastructure and not to pay off the federal debt.

Nevertheless, the administration did not flag in its efforts at privatising the GENCOS. When the opposition to the proposal to split and privatise Furnas threatened to stall privatisation, the administration agreed to change the privatisation strategy. Instead of splitting and selling Furnas to strategic investors, the administration decided maintain Furnas as a single firm and to sell shares in the company directly to the public, with the government retaining a golden share. This process, known locally as pulverisation, had been employed previously in the case of Petrobras, whose privatisation would have been politically even more controversial. For Chesf, in order to overcome political resistance, the administration offered to use the funds accruing from its privatisation to fund a long-standing pet project of North-East politicians—the transposition of the waters of the São Francisco River.[17] Similarly, offers of development assistance and promises to use the privatisation proceeds locally were made to the politicians stalling on Eletronorte.

Despite the administration's determination and the compromises that it made, various legal and logistical problems kept delaying the privatisation of the GENCOS until early 2001. The administration, however, persisted with the privatisation plans and it was only the looming rationing and the presidential elections scheduled for the following year that pushed generation privatisation off the near-term policy agenda.

4.4. The Stubborn Stumble towards Power Rationing

It was already apparent when the Cardoso administration began electric power privatisation in late 1995 that Brazil was in danger of suffering power shortages. One would tend to that conclusion by simply tracking the growth in electric power consumption versus the growth in installed capacity in the years preceding and following privatisation. In the 1970s, installed capacity grew at an average rate of 11.8% per year; in the 1980s, this fell to 4.1% per year and in the 1990s to a further 2.6% per year. Meanwhile, in the 1980s, power consumption increased at an average rate of over 7% per year and in the 1990s at over 4% annually. In the

[17]The project, known in Brazil as the transposition of the waters of the São Francisco river, involved building two canals that were thousands of kilometres to link the major river basins of the Northeast, thereby massively increasing the areas under irrigation.

three years after privatisation, which began when the power supply situation was already stretched tight, power consumption increased by over 15% but installed capacity increases trailed behind at 10% (see Table 11).

The peculiar technical characteristics of Brazil's electric power industry, however, made it difficult to predict exactly what the potential power shortfall was and when the shortages would occur. As I mentioned earlier, over 90% of Brazil's electricity is produced by large hydroelectric dams and the level of water in the hydroelectric reservoirs depends upon rainfall, which in Brazil varies substantially from year-to-year. Brazilian electricity planners had, in fact, taken these variations into account when they designed the country's electric power system. The volume of water in the reservoirs needs always to be maintained at levels sufficient to allow hydroelectric plants to fully attend expected demand even if there is below-average rainfall several years in succession. Given that predicting rainfall years in advance is technically impossible, Eletrobras developed a computer programme called NEWWAVE to determine whether the levels in the reservoirs was adequate or if additional capacity needed to be built. NEWWAVE calculates the available power production capabilities under hundreds of different rainfall scenarios and existing installed capacity is considered inadequate if in more than 5% of the rainfall scenarios the system would not be able to satisfy expected demand. This probabilistic nature of security of supply in Brazil means that even with a severely stressed supply situation, power shortfalls and blackouts are not inevitable. If, in a given year, the rainfall is favourable, then the system can produce sufficient electricity to satisfy all demand, even if installed capacity is considered severely inadequate. As we will see later, it was this flexibility in the face of supply shortages that allowed the Brazilian government to gamble with its electric power reforms.

Although it was technically difficult to predict with certainty when shortages would occur, the rationing should not have come as a complete surprise because it was known for several years that the power supply situation was greatly stressed. Based on the probabilistic determination described above, various studies indicated that it was likely, given the trends in electricity consumption and investment, that the risk of power shortage would surpass the 5% level by 2000. As early as 1996, a BNDES study indicated that Brazil faced an elevated risk of rationing after 2000. Even the consultants contracted by the Ministry of Mines and Energy concluded that Brazil would face an elevated risk of rationing if generation investment suffered any delays (Coopers&Lybrand 1997).

Despite these warnings, few in the policymaking circles publicly expressed preoccupation with the supply situation in the initial years of the electric power privatisation process. By late 1999, however, the difficulties in privatising generation had become apparent as had a growing threat of power shortages. Reports of the reservoir levels released by ONS were providing clear signals that the country was gambling with power deficits. After 1999 proved to be relatively dry, hydropower reservoir levels fell to 19.7% of total capacity at the end of November in the SE/CW and to 15.9% in the NE. The risk of rationing was elevated to 15% against the normal benchmark of 5%. Even this elevated risk of rationing was an optimistic estimate, given that the ONS based its calculations on the assumption that several power plants that were then under construction would all come online on time. The situation would have been even more critical had Brazil's economy continued to grow in 1999. Instead, the international financial crises and the resulting instability of the Real had restricted Brazil's growth in 1999 to 0.8% as opposed to over 3% per annum over the previous five years. Consequently, power

consumption in 1999 increased by only 1.6% as opposed to an average of over 5% per annum during the previous five years (see Table 11).

Brazil escaped power rationing in 2000 because of lower than expected power consumption and some providential rains in 1999 but the authorities did not take much advantage in 2000 of the respite that the economy and nature had provided. A year later, by January 2001, Brazil's hydropower reservoirs were again practically depleted (See Chart 6). The reservoirs in the NE were down to 10% of their storage capacity while those in the SE/CW were down to 18%. Only in the south were the reservoir levels healthy, but because of a lack of an integrated transmission capacity, little of the excess power available in the south could be distributed to other parts of the country.

Contemporary news accounts were full of warnings that the country was certainly headed towards power rationing, yet even as late as 2000 the administration and the Ministry of Mines and Energy continued to publicly deny the risk of rationing. Meanwhile, the administration redoubled its efforts on privatisation, accepting compromises that it had earlier resisted such as the pulverisation of Furnas and bargaining on political favours such as the transposition of the São Francisco River in exchange for assent on Chesf privatisation. Although prior to the devaluation, it could have been argued that privatisation was essential to maintaining the exchange rate and economic stability, by 2000 this objective could no longer be argued.

While the power supply situation turned critical, the administration decided not to take advantage of the ready technical capabilities, project execution capabilities and favourable balance sheets of the newly reformed GENCOS. Instead the administration launched a Priority Thermoelectric Power Programme (PPT), which aimed to provide the private sector financing incentives via the BNDES to construct almost 50 natural gas driven thermal power plants with an installed capacity totalling over 17,000 MW.

Initially, the administration assumed that the lines of credit and other financial incentives provided to the PPT by BNDES would be sufficient to induce private investment. While BNDES financing did solve the critical problem of the scarcity of long-term financing in Brazil, it did not, however, solve the more critical issue of the commercial viability of thermoelectric plants in the Brazilian electric power context. On one level, thermoelectric plants were preferred by private investors in Brazil. They have a lower capital outlay and come online much faster than hydroelectric plants. Given the risk and uncertainty of long-term capital intensive investments in Brazil, a faster concept-to-cash-flow was preferred by investors. However, thermoelectric plants suffered from the serious flaw that their fuel, natural gas in this case, had to be imported since at that time Brazil had not developed significant sources of domestic natural gas. The government had, however, built a gas pipeline from Bolivia and there were also possibilities of importing gas from Argentina but the main problem was that this gas had to be paid for in dollars.

Pricing of natural gas in dollars made the signing of power purchase agreements (PPAs) with DISCOS problematic. The first and immediate problem was that the pass-through of wholesale electricity purchases to the consumers was governed by ANEEL. In 1998, ANEEL had established a price ceiling for this pass-through which, in accordance with the Real Plan, could not be indexed in any manner to the price of the dollar. Adjustments to the price of power based on variations in the cost of natural gas could be made on an annual basis, but any variation in the price of gas during the year would have to be borne either by the DISCO or by the

generator. In any case, the pass-through ceiling, called the normative value (VN) established by ANEEL was already too low. Initially, ANEEL fixed the VN of natural gas based thermoelectric power plants at R$ 72.35 per MWh which was too low to enable the plants to run profitably. Subsequently, under the PPT, ANEEL increased the VN to R$ 106.40 per MWh for plants smaller than 350 MW and R$ 91.06 for plants larger than 350 MW.

The gas pricing issue was not the only hurdle for the PPT. In the short term, there was not any commercial space for the PPT power plants to sell their power. During the privatisation process, the federal GENCOS were made to sign initial contracts with the distribution companies and according to these contracts, 100% of the DISCOS' power requirements were covered by the GENCOS until 2002. Consequently, DISCOS believed that in the event of a power shortage, it would be the GENCOS that would bear the liability. As such, they were not inclined to sign power purchase agreements with the PPT projects. In the longer term, problems with contracting stemmed from the fact that ANEEL continued to maintain that the electric power sector would be deregulated according to the schedule previously established. The proposed liberalisation of the power sector at the retail level impeded DISCOS from signing PPAs with thermoelectric plants because being trapped into contracts with these relatively expensive sources of power supply would make them less competitive in the future. As such, DISCOS preferred to wait rather than immediately secure future supplies with thermoelectric generators.

Theoretically, given the scarcity of electric power there was a possibility that investors would build merchant plants—those that would sell only in the wholesale market as and when the scarcity value of electricity be high enough to allow these plants to be dispatched profitably. Indeed, a couple of investors did begin constructing such plants predicting, correctly, that the country would soon have to confront power shortages which would cause a spike in the price of wholesale power. For the majority of investors, however, merchant plants were too risky. Profit from these plants could be made only if there was enough power scarcity (i.e., the country should be running a substantially high risk of deficit). Given the nature of Brazil's hydroelectric power infrastructure, these periods would be few and far between.

The PPT remained paralysed for months as a result of the impasse created by the dollarisation of the natural gas prices, the Real Plan's prohibition of the denomination or indexation of public service prices in dollars, and the lack of incentives and a commercial space to sign power purchase agreements. It was only after the country was already at the brink of rationing that the government engineered a solution. Given that the private investors were refusing to accept the foreign-exchange risk, there were only three realistic options available to the government. The first was for the government to assume the risk directly through the treasury, explicitly guaranteeing protection to the investors against the risk of devaluation. The second was to place the risk on the consumers by explicitly or implicitly linking power rates to movements in the exchange rate. The final option, which the government eventually chose, was to require Petrobras, Brazil's federally owned oil & gas company, both to assume the foreign exchange risks and to enter into strategic partnerships with private investors in order to construct some of the thermoelectric power plants. Consequently, of the 49 plants originally conceived in the PPT, only 15 progressed beyond the concept stage and only because Petrobras was a strategic partner in these ventures. In order to control the foreign exchange risk for the investors, the administration finally fixed the price of gas at US$ 2.475 per mBTU, which was composed of 20% national gas at between US$ 2.00 and US$ 2.20 per mBTU and imported (Bolivian) gas at US$ 3.30 per mBTU, with Petrobras assuming the risks of any adverse movements in the

currency markets. Furthermore, the administration required Eletrobras to sign PPAs with the thermoelectric plants, thus shifting commercial risks to the state-owned entity.

With the government assuming most of the risks, it appeared that the commercial problems with the thermoelectric plants had been resolved. In a final blow to the PPT, however, the scarcity of turbines in world markets further delayed the construction of the plants. To accelerate deployment, some plants even opted to use modified aeroplane engines. As a result of the delays, the plants that finally went on-line were much more expensive than originally envisioned. Nevertheless, thermal power investment was much lower than expected. In the meantime, the hydropower reservoirs continued to be drawn down. By April, the rains had failed and the reservoirs were down to 11%

Finally, in May 2001, ONS warned that an immediate reduction of 20% in electricity consumption was essential in the SE/CW and NE to avoid a complete depletion of the reservoirs. To deal with the crisis, the administration immediately created an energy crisis management committee (CGE). To avoid the co-ordination problems that had plagued the industry transformation thus far, CGE included all the relevant actors—the ministers of mines and energy, finance and planning, the Advocate General, ANEEL, ONS, BNDES and Eletrobras. In choosing between generalised power cuts and voluntary power reduction, CGE favoured the latter. All classes were required to economise. Residential customers whose consumption was over 100 KWh/month and commercial customers had to reduce their consumption by 20% and industrial consumers by between 20 and 25%. To promote economic efficiency, CGE allowed firms who were able to reduce their consumption more than required to sell their rights to other consumers.

The rationing programme was successful in that Brazil avoided blackouts that generally plagued other places, such as California, that suffered energy shortages but the ten months of rationing severely impacted Brazil's economy and the financial health of the electric power sector. Various estimates put the combined industry losses at over R$ 10 billion. In addition, most of the contractual arrangements in the industry were in shambles with DISCOS, GENCOS and ONS blaming one another for bad planning. The issue of legal liability was hotly debated. The DISCOS believed that according to Annex V of their contracts they were covered for losses incurred in the case that GENCOS did not supply the power which they had contracted. GENCOS refused to accept responsibility and argued that not only had they been prevented from expanding capacity but also that ONS had erroneously continued to dispatch their cheaper hydropower rather than engaging more expensive thermal power, perhaps in an effort to keep prices low or perhaps because of a technical problem with the NEWWAVE electricity dispatch software.

In the end the Cardoso administration managed to hammer out an industry accord in which in exchange for the power companies renouncing the right to seek further and future legal recourse, BNDES would loan the power companies a negotiated amount representative of the losses that they had incurred. This loan could, in the books of the companies, be treated as income for the current year. The companies, in turn, would be allowed a special 10-year surcharge on electricity rates—2.9% for residential customers and 7.9% for industrial customers—to cover the cost of the loan. The government thus created an asset for itself (the loan made by BNDES), the companies realised income and profit (the same loan) and the consumers first had to curtail their consumption and then to pay over a period of 10 years for the power they were not allowed to consume.

Other relationships in the industry also suffered. Newspapers reported that the President blamed the Chairman of ANEEL for not having warned of and averted the power rationing and ANEEL itself was relatively sidelined in the CGE. Following the rationing, the administration made an attempt to salvage the electric power industry model that they had introduced in 1998, but the power reforms were essentially dead. During the presidential elections the following year, none of the candidates, not even Jose Serra from Cardoso's PSDB, declared themselves in favour of continuing with electric power privatisation.

5. Privatisation as Ends Instead of means

Scholars have generally argued that privatisation in Latin American was driven mostly by pragmatic concerns about getting enough investment and the policy pronouncements emanating from Latin American administrations also reflected this concern. In Brazil, according to the statements attributed to President Cardoso in the period before and after the rationing, privatisation of Brazil's electric power infrastructure was necessary because the state was unable to make the investments required to ensure adequate power supplies for the country. It would certainly appear, based on such pronouncements, that the administration was preoccupied with the pragmatic concern of ensuring the security of electricity supply in Brazil.

There can be little doubt that at the beginning of the 1990s, Brazil desperately needed to reform its electric power industry and obtain a more reliable source of investment. A static interpretation of the situation certainly gives the impression of privatisation as a pragmatic reaction. But, a dynamic analysis of the policy decisions taken during this period indicates that despite its stated preoccupation, the administration prioritised privatisation over investment in new generation capacity. The previous section provided evidence that there were ample indications of a looming energy crisis and that although privatisation of generation infrastructure proceeded much slower than originally envisaged, the administration repeatedly bypassed state-owned companies in developing plans to overcome the energy supply crisis. In doing so, the Cardoso administration pursued privatisation as the "end" of its policy to the detriment of investment in the new generation capacity. This section analyses how tensions appeared between the means and the ends and the processes by which they came to be muddled.

5.1 How Means and Ends came to be Muddled

The muddling of means and ends in Brazilian electric power privatisation did not become apparent until the process had been underway for several years. In the beginning, there was little tension between means and ends, which is to say that the measures that the administration took to facilitate the privatisation of the industry—the *means*—were exactly those that were required to promote a sustainable investment programme—the *ends*. First, preparation for privatisation required rate reform because securing investment was predicated upon investors (private or public) receiving an adequate rate of return. Second, the industry was restructured as part of the privatisation programme and this was critical to allowing competition in the various segments of the industry in the future. Third, privatisation initially led to some quality of service problems, basically because investors were interested in recuperating their investments as quickly as possible, but after ANEEL began to fine the concessionaires for the service problems, the issues were generally and quickly resolved. This led to infrastructure upgrades and improvements in the quality of service.

5.1.1. Public Finance for Private Investments

Although there were few tensions between means and ends in the beginning, there were strong signals that privatisation was being prioritised over other objectives in the government's power sector reform programme. Despite an outward determination to withdraw the government from the electric power sector, the Cardoso administration actively employed state resources to ensure "private" investment. This paradox was evident from the very beginning when, as Brown (2002) observed, Rio Light, a state-owned firm was bought by a consortium led by Electricité de France (EDF), another state-owned firm (albeit French) in a transaction financed by BNDES, a state-owned bank and the process was celebrated as "privatisation". In fact, almost throughout the privatisation process, BNDES made available up to 50% of the reserve price as a loan to the eventual winners. BNDES funds were also made available to private investors to expand electricity infrastructure. The level of BNDES financing in the sector became so significant that the state-owned electric power companies began to complain, only half-ironically, that they were at a competitive disadvantage because they were not allowed access to the low-cost BNDES funds. BNDES was not the only source of public money being provided to private investors in the power industry. In several subsequent privatisations, funds originating from other state-owned entities, such as Banco do Brasil's workers' pension fund, Previ, (one of the largest in the country) also figured prominently in the investor consortia. For example, a consortium headed by Spanish Ibredrola bought Coelba, Bahia's DISCO, but Banco do Brasil and Previ's share in the consortium was almost the same as Iberdrola's. In all of these cases, the administration applied pressure on government-owned financial institutions to apply resources to facilitate privatisation.[18]

The purpose of using BNDES funds was to promote privatisation not investment. If privatisation was intended to bring in foreign and private investment, then BNDES financing was counterproductive in that it would have a substitutive rather than complementary effect. Brown (2002), instead, has hypothesised that BNDES funds were used in order to make Brazil's "balance sheet" look stronger. Providing low-cost financing via BNDES helped inflate the final sales price of the privatised electric power companies. This allowed the government to creatively "pay off" more of its debt. By making loans to private investors, the government created an asset for itself (the loan) while part of the outlay came right back as a premium on the sale price. This view is supported by public statements made by senior BNDES executives where they confirm that BNDES funding was vital to making sure privatised power companies fetched a high price. The downside of increasing risk to public moneys was not articulated, nor was the fact that the higher capital outlays made by private investors would have to be later compensated through higher electricity rates.

5.1.2. The Means Displace the Ends

The simmering tensions between means and ends really manifested themselves in the beginning of 1999. Until that time, the privatisation of distribution companies had proceeded at a steady pace and was virtually complete. It appeared that with the passage of the enabling

[18]Technically, the investments being made in the power sector were private even though it was BNDES or Banco do Brasil that provided most of the money. The state only acted as financier but that did not immunise it from risk. Years later, in 2002, when Eletropaulo threatened to default on its BNDES loan repayment, it was the government that was forced into an unfavourable debt renegotiation.

legislation in 1998, the privatisation of generation companies would follow suit. Since the privatised distribution companies had, after some delay, began to ramp up their investment programmes, there was a general expectation that generation companies would do the same. In 1999, however, a series of problems attacked the Brazilian economy in general and the power sector in particular.

As the privatisation of generation companies began to flounder, the tensions between means and ends really became apparent. In responding to the setbacks in the GENCO privatisation schedule, the Cardoso administration committed a series of strategic errors that delayed investment and eventually led to power shortages. These errors, motivated by a strong commitment to privatise the electricity infrastructure, evidence the administration's pursuit of privatisation beyond pragmatism.

Amongst the most serious of the various strategic errors of the electric power industry reform and the most compelling evidence of the Cardoso administration's faith in the privatisation idea, was its determination to withdraw state investment in the generation sector even before private investment had taken hold. The supply situation in the industry was already tight when the Cardoso administration had initiated the electric power privatisation programme in 1995. Installed capacity had been trailing demand increases for many years because of the restrictive rate policies followed by previous governments. In addition, power demand accelerated after the Real Plan because the resulting monetary stability stimulated consumer demand and industrial production (see Table 11). Consequently the power supply markets became even tighter. It was precisely at this time, in April 1995, that the Cardoso administration entered the Eletrobras generation companies in the PND. This resulted in a substantial curtailment of their investment programmes (see Chart 5). The government also withdrew many concessions to develop hydropower sites that had been awarded to the GENCOS in order to free them for the private sector to develop later.

Because of their commitment to the idea of privatisation, the administration pursued it beyond pragmatism. The main evidence for the claim that the Cardoso administration focused its energies on privatisation even to the detriment of investment in new generation capacity and ensuring security of electricity supply is that it did not allow the federal GENCOS to ramp up their investment programmes even when the power supply situation was becoming seriously compromised. The initial power industry reforms of 1993 had set the stage for the recuperation of the financial health of the GENCOS. Nonetheless, the Cardoso administration retained curbs on the Eletrobras companies' investment programmes because it wanted to reduce their outstanding liabilities in preparation for privatisation. The GENCOS' increasing revenues were therefore applied to paying down their debts. Between 1995 and 1997, Furnas' debt was more than halved, from R$ 5.65 billion to R$ 2.72 billion. Eletrosul's debt reduction was even more dramatic: in two years it slashed its debt 80%, from R$ 1.45 billion to R$ 300 million. Given its balance sheet, debt levels and projected cash flows at that point in time, Eletrobras could, were it not under restrictions imposed by the federal government, have invested up to US$ 7 billion per annum. Instead, Eletrobras investments were less than US$ 3 billion per annum during this period. This meant that in the three years during which the DISCOS were being privatised, investment in generation did not receive much priority. Consequently, the security of supply situation steadily deteriorated, evidenced by the fact that in each year following 1996 the levels of the hydropower reservoirs were always less than those in the corresponding period in the

preceding year (see Chart 6). In other words, the reserve stock of water, necessary to guarantee the security of electricity supply, was steadily being depleted.

By requiring that the bulk electric power investments be made by the private sector instead of the already established state-owned generation sector (that still controlled 78% of the nations generating capacity) the administration slowed investment in new generation capacity. Eventually, Brazil ended up paying much more for electricity than it would have had to had the investment been undertaken by the federal GENCOS. Because of the delays in investment, the government needed to increase installed capacity much more quickly and was thus forced into promoting a larger-than-necessary thermal power plant development programme. A more judicious mix of hydroelectric and thermal power plants would have yielded lower overall costs but hydroelectric plants would have taken much longer to construct. To expedite the projects even more, the government told the investors to build plants that used the more expensive single-cycle turbines. The subsidised funding and other contractual concessions that the government was compelled to offer given the critical state of power generation added even more to the cost of power supplied.

Furthermore, in insisting that the investment in new power generation had to come from the private sector, the Cardoso administration was forced to deny that the threat of power deficits was both real and serious. The administration could hardly afford to admit that there was already an elevated risk of rationing and at the same time refuse to allow state-owned GENCOS to increase their investments. Consequently, Brazil failed to implement less drastic and cheaper energy conservation measures earlier on.

The administration also did not create any contingency plans to avoid power shortages even as evidence mounted that the privatisation of GENCOS and IPP investment was not going according to plan. In 1999, the administration failed to privatise the GENCOS because they had underestimated the complexity of preparing the firms for privatisation. In Furnas' case, for example, the firm's liabilities towards its workers' pension funds stalled privatisation until the government agreed to have BNDES absorb the liabilities. Despite repeated setbacks, Rudolfo Tourinho, the Minister of Mines of Energy, repeatedly pronounced that all three remaining GENCOS would be privatised in 2000. The Minister also declared, even as investors complained about the high natural gas prices, that the administration's thermal power programme was "a reality" and that it would "not be affected under any hypothesis and will not suffer any type of interruption." While it may be argued that it was only political bravura compelling the minister and senior administration officials to make such confident pronouncements, it is also undeniable that behind the scenes the administration did nothing to prevent the looming energy crisis, which had been evident since 1996 (see Chart 7) and had only been postponed because the pluvial conditions were unusually favourable in 1997 and 1998. The truth, which was evident to all sector professionals, was that Brazil was depleting its hydropower reservoirs faster than nature could replenish them.

It was at this point that the tension between means and ends was the starkest. Given that the generation companies had improved their financial health over the previous several years, they were now in a position to significantly increase investments in the short term through both debt and equity financing. Furthermore, Brazil's state development bank, BNDES, was also in a position to apply a substantial chunk of its portfolio to power investments. The choice that the administration faced at this point was whether to continue pursuing a very uncertain programme

of private investment in electric power or proceed on a more predictable and manageable path of increasing state investments to see the crisis through and then re-starting the privatisation initiative. Given the nature of the emergency that was evident at the time, the latter path would have been the more prudent choice. The administration, however, chose the former strategy and continued to restrict the Eletrobras companies' investment.

Subsequent policy decisions revealed the extent of the administration's bias against public investment. To facilitate private investment, the administration transferred most of the commercial and financial risks to the public institutions. The administration did make available increasing amounts of finance for the sector via BNDES, but all of these loans were extended to only the private sector. When it became obvious PPT would not take off, the administration pressured Petrobras to sign on with private investors as a strategic partner. It then required Eletrobras to sign power purchase agreements with any of the PPT projects that might be constructed. Petrobras was also required to assume the foreign exchange risk associated with the purchase of natural gas for electric power plants. Thus, although the state did have the resources to finance a massive electric power capacity augmentation programme—after all, 80% of the finance for the 17 GW PPT was to come from BNDES—the administration refused to allow state-owned GENCOS to invest directly increasing generation capacity.

5.2. Muddling through an Inaccurate Conceptualisation of the SOE Problem

Had the Brazilian power rationing been caused by the fact that the state had no available resources and was therefore powerless to intervene, or by the fact that high quality technical staff and advice were not available in the sector, or even by the fact that the administration was caught unawares by the gravity of the supply situation, then the rationing would not have been surprising from a policy perspective. However, what this paper has shown is that none of these three conditions were satisfied. What, then, can explain the anomalous results of the Brazilian power reforms experience? An answer is to be found in identifying and analysing the conceptual frameworks within which the administration was operating.

In Brazil, as in other highly indebted countries, privatisation was constructed upon orthodox economic rationalising. According to neo-liberal thinking, state profligacy had hobbled economic growth by creating fiscal imbalances and causing monetary instability. With privatisation, the neo-liberals argued, governments could use the proceeds to repay their debts, which would then initiate a virtuous self-reinforcing cycle of lower interest rates, increased investment and economic growth. Shedding perennially loss-making state enterprises would further ease pressure on state finances and possibly even free up resources for other, more pressing, social, educational and health projects. For the neo-liberals the withdrawal of the state from the productive sphere had to be as extensive as possible and, arguing that privatised firms would be more efficient, they exhorted governments to sell even profitable industries and enterprises.

Neo-liberal thinking thus promoted a symbolic generalisation of state ownership as inefficient and ultimately harmful to the domestic economy. It was symbolic in that it relied mostly on a stylised model of the ills of the public sector and was motivated by the desire to promote a specific reform strategy. Efficiency is almost always an issue upon which state ownership is faulted and the case of the Brazilian electric power industry was no different. Privatisation advocates blamed state ownership in general and the guaranteed remuneration

clauses of the 1934 Water Code for promoting inefficiency in the entire spectrum of the industry (see, for example, Pires, et. al 2001). The Collor and Cardoso administrations championed the privatisation of Brazil's electric power industry—and other state-owned enterprises (SOEs) as well—with similar claims. Both claimed that Brazil's state entrepreneur model was exhausted because SOEs were inefficient and were responsible for Brazil's huge debt problem and both revealed their commitment to the idea of private infrastructure ownership.

But, was the symbolic generalisation accurate? Amongst the various state-owned power firms in Brazil there is a wide variation in efficiency. The federal GENCO Furnas along with the state government owned vertically integrated firms Copel and Cemig were widely believed to be amongst the technological leaders in hydropower development and to be efficiently managed. Indeed, even after many power firms were privatised, state-owned firms such as Copel continued to be ranked amongst the best Brazilian and Latin American power firms. State government owned DISCOS were generally considered much less efficient, but even amongst these some such as Santa Catarina's Celesc were certainly not grossly inefficient. As far as the criticism against the 1934 Water Code is concerned, various forms of rate of return regulation, such as cost-plus or guaranteed remuneration, were until very recently standard practice globally and, in fact, had been adopted in Brazil when the electric power industry was almost completely privately-owned. Since such regulation was not a symptom of government ownership, any inefficiency resulting from the guaranteed remuneration clauses of the Water Code had less to do with government ownership than it did with the limitations of monopoly regulation.

A problem much more critical than the real or perceived operational inefficiency of Brazilian state-owned power companies was that these firms, because of their heavy debt loads, were forced to commit a large proportion of their revenues to debt service and were thereby severely handicapped in making new and required investments. Analysts tend to blame state ownership for this heavy debt load. There is some anecdotal evidence to suggest that this was the case. Some Brazilian power firms were certainly not very efficient and there is evidence to suggest that some generation projects, most notably the massive Itaipu Dam that Brazil constructed on its border with Paraguay and the Porto Primavera hydroelectric project initiated by São Paulo's CESP may not have been economically justified when they were initiated.

This does indicate that state ownership was certainly problematic but a closer investigation of government policy in the power sector reveals that the case against government ownership of power firms in Brazil is much more nuanced. Internal management problems were not at the root of the crisis that the power industry found itself in during the late 1980s and early 1990s. The primary culprit instead was the electricity rate control imposed by the federal government from the 1980s onwards that prevented power firms from making an adequate return on their investment: In 1974, retained earnings financed almost half of the total electricity investments and direct government transfers another fifth. Foreign loans financed only 13% of the investments. Between 1974 and 1986, however, real electricity rates fell by almost a third and in the early 1990s fell by another third. As a result, foreign loans began to finance over half of the power investments, whereas retained earnings financed less than a fifth.

Would private ownership of electric power assets have forced government into following a different strategy? Examining the history of the Brazilian electric power industry reveals that the government, in fact, followed similar policies of rate controls even when the power firms were privately owned (Tendler 1968). Indeed, the common complaint of infrastructure investors

in Brazil, and often elsewhere in Latin America, was that the government did not allow rates sufficient to cover capital and operational costs. Public ownership was therefore only incidentally related to the government's decision to not allow electricity rates to keep pace with inflation.

The tendency to conflate state ownership with government policy is a common problem in analysing SOE performance. If SOEs are unprofitable and debt-ridden, it is often because governments, for various economic and social reasons, consciously choose a policy of unremunerative prices for the sector in which these firms operate and not because the firms are owned by the state. If there is a correlation between unremunerative rates and government ownership it is because private investors tend to sell their assets when rates of return on assets fall below a certain threshold and the industry automatically comes to be dominated by the state. Indeed, facing similar rate controls as other SOEs, the two major private electric power operators in Brazil had preferred to sell out to the federal government. In 1963 Amforp sold its assets in Brazil for US$ 135 million just before the military government passed through a series of rate increases, the first in about 30 years. The other remaining investor, the Light group, sold its interests to Eletrobras in 1979 after the Brazilian federal government again began limiting rate adjustments and would not allow compensation for earnings eroded by inflation

State-ownership is thus more a symptom of underlying policy failures at the macroeconomic level than a cause in itself for the problems confronting the Brazilian electric power industry. Brazilian state-owned electric power companies became mired in excessive debt not because their management made strategic mistakes nor because they treated capital investments cavalierly but because the federal government did not allow them to adjust their rates even to keep pace with inflation, a policy that was very similar to the one forced on to the firms when they were in private hands.

In reality, the Brazilian public sector power firms, far from being the cause of the government's fiscal problems, initially contributed to ameliorating immediate fiscal and balance of payments pressures. Before the economic crises of the 1970s and 1980s, Brazilian electric power companies—and SOEs in general—were largely self-financing through their rates and through taxes earmarked for the industry (see Table 8). While the credit crunch began to affect Brazil government borrowing, past reputation and efficiency ensured that Brazilian state owned power companies continued to enjoy easier access to foreign finance and it was these firms that ended up bringing in the foreign exchange to finance the government's balance of payments deficits and rolling over the debt. Even so, of the public sector borrowing requiremet (PSBR) of 3.7% of GDP in 1986-91, over 60% (2.3% of GDP) was accounted for by federal and state government spending and only 1.4% by SOEs. This was very different when we compare it to, for example, Argentina where the SOEs alone were responsible for a PSBR that amounted 3.3% of GDP (ECLA 1988).

Nevertheless, the standard neoliberal claims about inefficient SOEs resonated strongly in Brazil as similar views were widely held with respect to most of Latin America in both the popular and the academic presses. Consequently, it was assumed that state ownership caused uneconomic pricing and that privatisation was necessary to solve the problem of appropriate pricing for infrastructure services. Policy entrepreneurs often presented privatisation as a preferred solution to the problem of insufficient prices charged by SOEs. They have argued that political exigencies are often too strong for politicians to resist calls for populist pricing of public

services or, once implemented, to repeal populist pricing. They have recommend privatisation precisely because it serves to deflect this political pressure. Their conceptualisation is consistent with a diagnosis that state-ownership is the root cause of distorting pricing policies forced by politicians.

In the general case, while pricing reform has, in fact, accompanied privatisation initiatives, such reforms have usually preceded privatisation. The motivation to privatise leads to rate reform basically because investors are unlikely to bid for assets while rate controls are still in effect. Indeed, most analysts have often advised that pricing reform be conducted before privatisation so as not to expose the private investors to political protests. Privatisation as a political cover for pricing reform thus appears to be theoretically attractive but is, in reality, an exception to established practice.

In any case, unlike other developing countries, Brazil's electricity structure was not populist. Instead, residential power prices provided part of the subsidy for industrial power. Brazilian policymakers had kept industrial prices low to promote industrial development and, more importantly, to control inflation. Therefore, privatisation would not facilitate price reform by, as is commonly argued, insulating government from populist pressures to keep electricity prices low.

On the contrary, liberalising electric power prices—a pre-requisite for privatisation—would once again threaten to push inflation, the control of which was the centrepiece of various economic stabilisation efforts. In the meantime, the Brazilian economy and industry, especially the electro-intensive firms, had become used to low electricity prices. Given the rate controls practised during the period leading up to the reforms, electricity prices would rise regardless of whether the sector was privatised or not. After privatisation, however, investors would be much more sensitive to any future efforts of the government to moderate electricity prices and might well delay their investment until the government provided them with credible guarantees.

Thus the symbolic generalisation, while popular, was inaccurate and it contaminated the analytic framework that was being developed to reform the Brazilian electric power industry. Reforming the Brazilian electric power industry was predicated on rate reform and while privatisation was a strong motive it was not a prerequisite for reforming electricity rates. The real reforms were required at the policy level which affected both private and public firms because without such reforms even privatisation would fail. But, the conceptual framework upon which the administration's reform strategy was based assumed that the financial disequilibrium in the electric power industry was caused by problems internal to the management of the firms. The administration was, in effect, claiming that even though electricity rates had been rationalised, state-owned electric power firms still could not operate efficiently.

This incorrect conceptualisation of the problems with Brazilian electric power set into motion a series of strategic miscalculations. First, it led to strong causal reasoning within the administration and reinforced greatly the assumption that if the problem was state ownership, the only logical solution was privatisation. Consequently, in the administration's mindset, if privatisation were successful, other concerns would automatically resolve themselves. This faith-based approach to privatisation resulted in policy decisions geared towards immediate concerns about privatising rather than any comprehensive sectoral investment strategy. Having, however, misjudged and ignored the complexities of transforming the state-owned and centralised

electricity industry into a private and competitive one, the administration only outlined some general policy principles calling for a competitive electric power sector but did not create a strategic vision for the future of the industry nor a detailed transition plan. The lack of a transition plan facilitated muddling because there were no checklists, other than privatisation, against which the administration could judge progress.

Those that did not share the administration's conceptualisation of the power sector's problems were, naturally, marginalised. These included those amongst the most experienced of Brazil's electric power sector professionals. The administration saw this as inevitable because it operated under the assumption that the power sector professionals themselves would have too many preconceptions and divergent opinions on electric power industry restructuring and too many vested interests to be relied upon to enable a smooth transition. In the administration's view, many of the senior power sector professionals were "corporatist" in the sense that they prioritised the institutional welfare of their organisations, such as Eletrobras or Furnas, over the general public good.

To overcome the opposition of the power sector professionals, many of whom openly expressed that privatisation and liberalisation as it was being conceived would seriously impact on the security of power supply in the country, Brazil's Secretary of Energy, Peter Greiner, contracted the UK office of Coopers & Lybrand to prepare an industry restructuring study in collaboration with these public sector power professionals. It took over a year for the study to be completed and the consultants presented the final report to MME in August 1997. The study was generally criticised for drawing too many of its conclusions from the British electricity industry, which is mainly thermal, rather than from the Brazilian electric power sector, which is overwhelmingly hydro-based. Even Cardoso later commented that the report was not particularly good or useful. However, even the prescient warnings that the report presented on the need for cautious transition planning and the importance of not delaying generation investment were ignored during the electric power privatisation process. The C&L report clearly stated that, "The demand for energy in Brazil will continue to increase rapidly and the country does not have any excess capacity. Imminent reforms will introduce uncertainties and tend to delay decisions. Brazil cannot risk interruptions in its energy investments." But, the government's faith was placed in privatisation as a self-driving and self-regulating process.

The effective isolation of many of the sector's most experienced professionals from the policymaking process contributed to the policy confusion and mistakes. Informational flows were compromised because, unfamiliar with how the Brazilian electricity system really worked, policymakers were forced to base their decisions on general principles borrowed from the workings of other foreign power systems. Warning signs were not heeded because their relevance was not comprehended. Consequently, despite having access to financial resources and despite the presence of a skilled technical capability in Brazil, the country suffered rationing.

5.3. Tenacity of Belief and the Muddling of Means and Ends

Traditional analyses of policymaking tend to follow a means-end continuum where policymakers observe an initial and unsatisfactory state of affairs (the problem) upon which they apply their chosen strategy (the means) in order to get to a final desirable state (the end). The choice of the means is one of the principal tasks of the policymakers and is conditioned strongly by how they define the problem and the intellectual approach that they bring to it. In any

complex policy programme, the means-end continuum cannot, of course, be a uniformly smooth process that moves along a precise predefined schedule. Frequent changes in operational strategies may be required and, sometimes, even a fundamental rethink of the chosen means.

During the implementation stages, changes in strategy can be forced by a variety of factors. For example, opposition by affected groups may be stronger than was originally envisaged. Or, the agencies charged with implementation may consciously or unconsciously subvert the policy. Policy changes may also be driven by changes in the economic environment in which they were originally conceived.

This last kind of policy change is what this paper has investigated. In such cases, policies when they were originally selected had a basis in the economic environment that existed and that which was expected. Changes in this environment can cause obsolescence in the policy. As the environment changes, policies become subject to diminishing returns up to a point where further pursuit of the policy leads to more harm than good. At this point and beyond, fundamental rethinks of the policy are called for.

Rethinks of strategies or means may be a normal part of the policymaking process but they are usually ignored by the traditional linear models of the policymaking process which assume that policy implementation follows from and closely adheres to the policy decision. How easy it is to perform a rethink is related to how closely linked the means are to the policymakers' operating paradigms. For example, writing about the reversals of privatisation, Vernon (1984) coined the term "obsolescing bargain". He proposed that developing country governments were naturally averse to foreign ownership and would tolerate it only to the extent that the benefits—infusion of capital, new technologies, better management practices, etc.—offset the disadvantage of foreign ownership. Over time, however, as these technologies and management practices become internalised and the foreign capital becomes less necessary, the bargain that foreign investors have with governments becomes obsolete and the latter become tempted to re-nationalise. Vernon's conceptualisation proved popular with privatisation scholars because it helped explain the cycles of privatisation and nationalisation. In Vernon's example, privatisation went contrary to the policymakers' operating paradigms and, therefore, was subject to easy reversal. Policymakers were always on the lookout for the turning or tipping points when the costs of privatisation outweighed their benefits.

An intriguing observation stemming from Brazil's power privatisation experience is that if a chosen means is compatible to the policymakers' operating paradigms, then it may, in fact, blind the policymakers and they may refuse to recognise that their bargain (in our case with private investment) has, in fact, obsolesced. Around 1998, the Cardoso administration's electric power reforms strategy was showing signs of obsolescence. The currency crisis had reduced investor interest in purchasing generation assets, a workable solution to creating a functional electric power market that would not lead to a price explosion had yet to be found and both of these problems had emboldened the political opposition to GENCO privatisation. Delay in GENCO privatisation was unavoidable while at the same time the supply situation was steadily deteriorating. A quicker and more efficient solution under these circumstances would have been for the government to reassume an immediate state-led investment programme and hope to re-commence privatisation after the power crisis was defused. Yet the administration repeatedly rejected these options, labelling those that suggested it as "corporatist" interests, and continued pushing for a bargain that had, for most other observers, already obsolesced.

When policymakers are unable to respond to situations that demand more fundamental rethinks, we can say that they are displaying a tenacity of belief.[19] The expression of the tenacity of belief through inflexibility in dealing with emerging problems reveals not only the policymakers' underlying assumption and motivations but also how strongly these are held. In the Brazilian electric power reforms case described in this paper the principal policymakers identified the problem as a lack of investment caused by state ownership, the means as privatisation and the end as obtaining sufficient investment for the industry via the private sector. The causal reasoning—state ownership leads to inefficient management and abusive pricing policies (abusive from the point of view of the capital invested)—and the symbolic generalisation about it reinforced by the national experience of the crisis years served to create a tenacious belief that privatisation was a unique, necessary, and perhaps sufficient strategy to conduct and conclude the power sector reforms.

Clearly then, the Brazilian reformers held a strong belief in the underlying theory of privatisation. While there were ideas about implementation that were open to further analysis and bargaining, the fundamental proposition about pushing privatisation was not. Kuhn's (1962) treatise on scientific revolutions helps explain why the administration might have ignored alternative solutions to the power investment problem. According to Kuhn, once paradigms are accepted, those who share them generally accept without question particular sets of problem-solutions. Solutions sets outside the paradigmatic framework are not acceptable and anomalies, if and when they do crop up, are usually discarded or ignored (Kuhn, 1962). The paradigm under which the Cardoso administration was functioning was, therefore, not open to questioning. The strength of this paradigm, even after the apparent obsolescence of the policies that derived from it, originates in the global dominance of the neo-liberal paradigm which I discussed in section II. It was reinforced by tendencies towards institutional isomorphism wherein any alternative to privatisation was not viewed as legitimate by the dominant policy community. These factors subverted the original ends of the privatisation programme by blinding the administration's ability to see turning points as well as alternative strategies as viable. If the means remains the only legitimate mechanism for arriving at the desired end, then automatically progress with the means is considered sufficient to measure progress towards the end. It is then, only a short step to muddling the means with the ends.

6. Conclusions and Implications

Policy fiascos are notoriously difficult to analyse, much less to conceptualise in general terms. The more complex the policy programme being investigated, the harder it is perform such analyses. Furthermore, it is difficult to say with any degree of certainty whether a policy fiasco has resulted from a flawed policy or from a flawed implementation, or both. This paper has only partly sought to perform such an analysis for the Brazilian electric power reforms. In this case, it would be impossible to deny that both formulation and implementation failures contributed to

[19]The concept of tenacity of belief was articulated by Charles Pearce in an article he wrote for Scientific American in 1877. In a short but influential article that remains popular even a century later, Pearce argued that the act of belief itself produces human satisfaction, even if the belief is false, and that there is a natural tendency to cling to beliefs. As he articulated it:

> Doubt is an uneasy and dissatisfied state from which we struggle to free ourselves and pass into the state of belief; while the latter is a calm and satisfactory state which we do not wish to avoid, or to change to a belief in anything else. On the contrary, we cling tenaciously, not merely to believing, but to believing just what we do believe.

the failure of the reforms. The narrative presented in section IV should have impressed upon the reader how complex the privatisation process really was.

What this paper has concentrated on, however, was a different question. Why was the government unable to avoid power rationing given the resources that were available to it? In order to answer this question, the paper has investigated the policy environment within which the reformers operated: section II of the paper described how neo-liberal ideas became hegemonic and coloured strongly the global policy process during the 1980s and 1990s; section III analysed how these global policy trends were translated into the Brazilian economic programme of the 1990s while section IV extended this analysis into the power sector; then, section V brought it all together by explaining how and why means and ends got muddled in the Brazilian electric power reforms.

This article differs from other privatisation analyses in that it does not accept that privatisation in Brazil was driven primarily by pragmatism or by external pressures. Rather it shows that the Brazilian power privatisation programme was driven by dynamics internal to the Cardoso administration. A pragmatic administration would have realised that the main problem for electricity investment were the price controls established in the industry and that after these controls were lifted private as well as public firms were able to make adequate returns on their investment. They would have also realised that given the looming power shortages it would have been cheaper and more efficient to employ state owned firms quickly to create the additional generation capacity that was required. On the contrary, even after the Real's devaluation, when privatisation no longer served a strategic purpose in the macroeconomic stabilisation plan, the administration remained committed to selling the GENCOS. When the administration realised that it would not be able to sell Furnas to strategic investors, it recommended instead selling Furnas' stock to the general public. In the case of Chesf, to overcome regional politicians' opposition to its privatisation, Cardoso promised to use the funds from Chesf's sale not to pay down the debt but to fund a massive scheme for the transposition of the River São Francisco, which was one of the Northeast politicians' pet projects. To help push through Eletronorte's privatisation, the administration again committed to using proceeds from the sale not to pay down the national debt but to invest it in expanding the north's electric power infrastructure. None of these efforts, however, paid off.

Despite the failures with electric power reform and the general economic chaos during his second term, Cardoso deserves credit for pushing through some fundamental reforms. His championing of fiscal discipline had a beneficial long-term effect in providing economic resilience even though his administration itself was not able to achieve fiscal discipline to the extent that it was required. Cardoso also established independent regulatory agencies which, although not perfect, are fundamental to creating institutional stability for future investments in infrastructure. Finally, the reform of the state-owned enterprises, even though that was done to prepare them for privatisation, has put them in good stead for the future.

On power reforms the Cardoso administration was confident, but wrong, about many aspects of the Brazilian electric power system. In believing that privatisation was both necessary and sufficient to resolve the electricity sector's troubles, the administration made the reforms process itself more vulnerable to planning and transitional errors and oversight. Indeed, a sequential view of the privatisation process reveals that the reforms often cannibalised themselves. Being absorbed by its preoccupation with privatisation and because of its abiding

faith in the strategy itself, the government overlooked its flawed assumptions about the ease of electric power privatisation and the ability of privatisation to singly solve the investment problem. While the government's reform programme kept faltering, the single minded pursuit of privatisation, even to the paradoxical extent of using government resources to finance the private sector, drove the country into the very situation that it was meant to avoid—a shortage of power. The resulting economic and financial losses were enormous and the eventual cost to the government, the private sector and the Brazilian economy in general was considerably more than would have been incurred had the government taken a more interventionist approach.

The power of the idea can blind reformers to its shortcomings. In the Brazilian case that I have analysed, the reformers, convinced that their chosen *means* was the one best way, viewed as failure even the contemplation of strategies other than privatisation. Thereby, when the programme began to stall, the reformers muddled progress towards the *means* with progress towards the *end* and redoubled their efforts on the former even as they distanced themselves from the latter. The danger of this sort of muddling is that other, more feasible, policy alternatives are summarily rejected. Cardoso administration's intellectual and ideological commitment, even in the face of rapidly obsolescing and failing strategies, drove the industry to crisis and greatly prejudiced Brazil's short-term economic growth. In fact, this paper has described a similar trend in fiscal and monetary policy where orthodox reform aimed at reducing the deficit to eliminate inflation and high interest rates ended up dramatically increasing Brazil's deficit and debt. Privatise at all costs thus ended up a very expensive proposition in Brazil.

REFERENCES

Alchian, A. 1965. "Some Economics of Property Rights", *Il Politico* 30.

Alchian, A. and H. Demsetz. 1972. "Production Information Cost and Economic Organization", *American Economic Review.*

Amsden, A. 1994. "Why Isn't the Whole World Experimenting with the East Asian Model to Develop? Review of the *East Asian Miracle*", *World Development*, 22 (4).

Baer, W. 2001. *The Brazilian Economy: Growth and Development. 5th Edition.* Westport: Praeger.

Bajay, S.V. 2001. "Reestruturacao do MME e Criacao de um Orgao de Apoio", Relatorio Tecnico, Departmento Nacional de Politica Energetica. Brasilia: Ministerio de Minas e Energia.

Brown, A. 2002. "The Privatisation of Brazil's Electricity Industry: Sector Reform or Restatement of the Government's Balance Sheet", unpublished manuscript.

Buchanan, J.M. And G. Tullock. 1962. *The Calculus of Consent: Logical Foundations Of Constitutional Democracy.* Ann Arbor: University of Michigan Press.

Demetz, H. 1967. "Toward a Theory of Property Rights," *American Economic Review Papers.*

Downs, A. 1957. *An Economic Theory of Democracy.* New York: Harper & Row.

Economic Commission for Latin America. 1950. *The Economic Development of Latin America and its Principal Problems.* New York: United Nations.

Evans, P. 1979. *Dependant Development,.* Princeton: Princeton University Press.

Feigenbaum, H. J. Henig and C. Hamnet. 1998. *Shrinking the State: The Political Underpinnings of Privatization.* Cambridge: Cambridge University Press.

Fishlow, A. 1990. "The Latin American State", *Journal of Economic Perspectives,* 4 (3).

Frieden, J.A. 1987. "The Brazilian Borrowing Experience: From Miracle to Debacle and Back", *Latin American Research Review* 22 (1).

Gall, N. 2002. "Apagao na Politica Energetica", *Braudel Papers #32.* São Paulo: Ferdinand Braudel Institute.

Gamble. A. 1989. "Privatisation, Thatcherism and the British State", *Journal of Law and Society*, 19 (1).

Giambiagi, F. and A.C. Além. 2001. *Finanças Publicas: Teoria e Prática no Brasil.* Rio de Janeiro: Editora Campus.

Gomes, A.C.S., C.D.G. Abarca, E.A.S.T. Faria and H.H.O. Fernandez. Undated. "O Setor Eletrico", BNDES memo.

Greiner, P. 2002. "Solucoes ao Inves de mais Confucao", *Braudel Papers #32.* São Paulo: Ferdinand Braudel Institute.

Hardin, G. 1968. "Tragedy of the Commons", *Science.* 162.

Hirshman, A. 1968. "The Political Economy of Import-Substituting Industrialisation in Latin America", *The Quarterly Journal of Economics*, 84.

Ikenberry, J. 1990. " The International Spread of Privatisation Policies: Inducement, Learning, and "Policy Bandwagoning" in E.N. Suleiman and J. Waterbury, eds. *The Political Economy of Public Sector Reform and Privatisation* Boulder: Westview Press.

Jenkins, P. 1988. *Mrs. Thatcher's Revolution: The Ending of the Socialist Era.* Cambridge, MA: Harvard University Press.

Kanbur, R. 1999. "The Strange Case of the Washington Consensus. A Brief Note on John Williamson's "What Should the Bank Think about the Washington Consensus"", paper presented as background to the World Bank's World Development Report 2000.

Kingdon, J.W. 1984. *Agendas, Alternatives and Public Policies.* New York: Harpers Collins.

Krugman, P. 1995. "Dutch Tulips and Emerging Markets", *Foreign Affairs*, July/August.

Kuhn, T. 1962. *The Structure of Scientific Revolutions.* Chicago: University of Chicago Press.

Leal, C.F.C. Undated. "Agios, Envelopes e Surpresas: Uma Visao Geral da Privatizacao das Distribuidoras Estaduais de Energia Eletrica", BNDES Internal Paper.

Lindblom, C.E. 1965. *The Intelligence of Democracy* (New York: Free Press).

----------. 1977. *Politics and Markets.* New York: Basic Books.

----------. 1990. *Inquiry and Change.* New Haven, CT: Yale University Press.

Majone,G. 1996. "Public Policy and Administration: Ideas, Interests and Institutions" in R. Goodin and H. Klingemann, eds. *A New Handbook of Political Science,* (Oxford: Oxford University Press).

Murillo, M.V. 2002. "Political Bias in Policy Convergence: Privatization Choices in Latin America, *World Politics.*

Niskanen, W. 1977. *Budgets and Bureaucrats: The Sources of Government Growth.* Durham, N.C.: Duke University Press.

Oliveira, A. 1997. *Perspectivas da Reestruturação Financeira e Institucional do Setor Elétrico Brasileiro.* Relatório de Pesquisa Patrocinado pelo PNUD/IPEA/FUNDAP.

Pearce, C. 1877. "The Fixation of Belief," *Popular Science Monthly*, 12 (November).

Perkins, D. H. 1994. "There are at least Three Models of East Asian Development", *World Development*, 22 (4).

Pires, J.C., J. Gostkorzewicz and F. Giambiagi. 2001. *O Cenário Macroeconomico e as Condições de Oferta de Energia Elétrica no Brasil.* Textos para Discussão 85. Rio de Janeiro: BNDES.

Porter, M. 1990. *The Competitive Advantage of Nations.* London: Macmillan.

Ramamurti, R. 1992. "Why are Developing Countries Privatizing?", *Journal of International Business Studies 23(2).*

Sappington, D. and J. Stiglitz. 1987. "Privatisation, Information and Incentives", *Journal of Policy Analysis and Management,* 6.

Schleifer, A. 1998. "State versus Private Ownership", *Journal of Economic Perspectives* 12 (4).

Sigmund, P. 1990. "Chile: Privatisation: Reprivatisation, Hyperprivatisation." In *The Political Economy of Public Sector Reform,* E.N. Suleiman & J. Waterbury (eds.). Boulder: Westview Press.

Silva, P. 1991. "Technocrats and Politics in Chile: from the Chicago Boys to the CIEPLAN Monks", *Journal of Latin American Studies, 23.*

Stallings, B. 1992. "International Influence on Economic Policy: Debt, Stabilisation and Structural Reform" in S. Haggard and R. Kaufman, eds. *The Politics of Economic Adjustment: International Constraints, Distributive Conflicts and the State.* Princeton: Princeton University Press.

Starr. P. 1994. "The Meaning of Privatization", *Yale Law Review.*

Taylot, P.J. 1994. "The State as Container: Territoriality in the Modern World-System", *Progress in Human Geography,* 18.

Teisberg, E.O. 1993. "Capital Investment Strategies under Uncertain Regulation", *The Rand Journal of Economics* 24 (4).

Temin, P and L. Galambos. 1987. *The Fall of the Bell System: A Study in Prices and Politics.* Cambridge: Cambridge University Press.

Tendler, J. 1968. *Electric Power in Brazil: Entrepreneurship in the State Sector.* Cambridge: Harvard University Press.

Trebat T.J. 1983. *Brazil's State-Owned Enterprises: A Case Study of the State as Entrepreneur.* Cambridge: Cambridge University Press.

Werneck, R.F. 1991. "Public Sector Adjustment to External Shocks and Domestic Pressures in Brazil" in F. Larrain and M. Salowsky, eds.. *The Public Sector and the Latin American Crisis.* San Francisco: ICS Press.

Williamson, J., 1993. "Democracy and the Washington Consensus", *World Development* 21(8).

----------. 1994. *The Political Economy of Policy Reform* Washington DC Institute for International Economics.

----------. 1999. " What Should the Bank Think about the Washington Consensus," paper presented as background to the World Bank's World Development Report 2000. www.iie.com/publications/papers/williamson0799.htm

Wolf, C. Jr. 1979. "A Theory of Nonmarket Failure", *Journal of Law and Economics,* 22.

----------. 1988. *Markets or Governments: Choosing Between Imperfect Alternatives.* Cambridge, MA: MIT Press.

Wolfe, J. 1991. "State Power and Ideology in Britain: Mrs. Thatcher's Privatisation Programme", *Political Studies* 34.

World Bank. 1993. *The East Asian Miracle: Economic Growth and Public Policy.* New York: Oxford University Press, 1993.

Table 1. The Most Indebted Countries in Latin America (US$ billions)

Country	1980	1990	1996
Mexico	57.4	104.4	160.0
Brazil	71.5	119.6	178.1
Argentina	27.2	62.2	99.1
Peru	9.4	20.1	33.6
Chile	12.2	19.2	23.0
Colombia	6.9	17.2	29.2
Venezuela	29.3	33.2	35.3
Latin America (total)	*257.3*	*474.9*	*629.1*

Table 2. External Debt 1968 – 2000 (US$ millions)

Source: Banco Central do Brasil

Year	Gross External Debt
1968	3,861
1969	4,403
1970	5,295
1971	6,622
1972	9,521
1973	12,572
1974	17,166
1975	21,171
1976	25,985
1977	32,037
1978	45,511
1979	49,904
1980	53,848
1981	61,411
1982	69,653
1983	81,319
1984	91,091
1985	95,857
1986	98,120
1987	121,188
1988	113,511
1989	123,439
1990	123,910
1991	135,949
1992	145,726
1993	148,295
1994	159,256
1995	179,935
1996	199,998
1997	234,694
1998	241,200
1999	241,469
2000	236,157

Table 3. Balance of Payments (US$ billion)

Source: Banco Central do Brasil

Year	Exports	Imports	Trade Balance	Service Balance	Profit Remittance	Interest	Current Account Balance
1985	25.6	13.2	12.5	-12.9	-1.1	-9.7	-0.2
1986	22.3	14.1	8.3	-13.7	-1.4	-9.3	-5.3
1987	26.2	15.1	11.2	-12.7	-0.9	-8.8	-1.4
1988	33.8	14.6	19.2	-15.1	-1.5	-9.8	4.2
1989	34.3	18.3	16.1	-15.3	-2.4	-9.6	1.0
1990	31.4	20.7	10.8	-15.4	-1.4	-9.7	-3.8
1991	31.6	21.0	10.6	-13.5	-0.7	-8.6	-1.4
1992	35.9	20.6	15.3	-11.3	-0.6	-7.2	6.1
1993	38.6	25.7	12.9	-15.6	-1.8	-8.3	-0.6
1994	43.6	33.1	10.4	-14.7	-2.5	-6.3	-1.7
1995	46.5	49.7	-3.2	-18.6	-2.6	-8.2	-18.0
1996	47.8	53.3	-5.6	-21.7	-2.4	-9.8	-24.3
1997	53.0	61.4	-8.4	-27.3	-5.6	-10.4	-33.4
1998	51.1	57.6	-6.5	-29.5	-7.9	-12.1	-34.4
1999	48.0	49.2	-1.2	-25.2	-4.1	-15.8	-25.2

Table 4. Annual Inflation Rates 1990 – 1999

Source: Banco Central do Brasil

Year	Annual Rate of Inflation
1990	1476.71%
1991	480.23%
1992	1157.84%
1993	2708.17%
1994	1093.89%
1995	14.78%
1996	9.34%
1997	7.48%
1998	1.70%
1999	19.98%

Table 5. Operational Deficits as a % of GDP

Source: Banco Central do Brasil

		Primary		Operational	Debt Increase under Real Plan
	Total	*Federal*	*Total*	*Federal*	
1990	2.4	1.6	1.6	2.8	
1991	3.0	0.8	1.5	0.3	
1992	2.3	1.3	-2.2	-0.8	
1993	2.6	1.4	0.3	0	
1994	4.3	3.0	0.5	1.6	
1995	0.3	0.6	-4.8	-1.6	
1996	-0.7	0.4	-3.9	-1.7	31.4
1997	0.9	0.3	-4.3	-1.8	34.5
1998	0	0.5	-8.4	-5.3	42.6
1999	3.77	4.15	11.4	8.0	51.0

Table 6. Public Enterprises Indebtedness (% GDP)

Source: Banco Central do Brasil

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Internal	8.5	11.4	9.7	8.4	4.9	4.8	4.0	0.9	1.3	1.4
External	6.7	9.3	6.5	5.6	1.9	1.7	2.0	1.9	1.3	1.7
Total	15.2	20.7	16.2	14.0	6.8	6.5	6.0	2.8	2.6	3.1

Table 7. BNDES Participation in Electric Power Investments (R$ million)

Source: BNDES

Year	Operations Contracted by BNDES	Total Investment	BNDES Participation
1995	1148	1480	77.60%
1996	1003	3062	32.70%
1997	108	214	50.50%
1998	1065	1886	56.50%
1999	1337	3001	44.60%
2000	1048	3766	27.80%
Total	5710	13408	42.60%

Table 8. Source of Power Investments (in %)

Source: Eletrobras

	1967	*1973*	*1979*	*1984*
Internal	34	44.9	24.2	17.9
Forced Loans	8.1	9.4	7.6	3.9
State Resources	31.9	20.3	6.1	6
Domestic Loans	13	6.6	30.1	9.4
Foreign Loans	13	18.8	32	62.8

Table 9. Average Real Electricity rates (1964 = 100)

Source: Eletrobras

Year	*Real rates*
1964	100
1969	150
1974	145
1979	106
1984	98
1985	93
1986	97
1987	102
1988	101
1989	71
1990	73
1991	72

Table 10. Privatisation Prices and Premiums Paid for Brazilian DISCOS

Source: BNDES

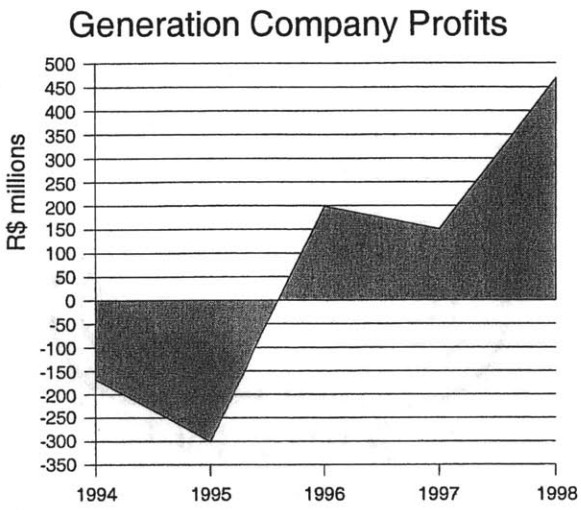
Firm	Value of Sale (US$ million)	Premium (%) Paid of Minimum Reserve Price	% of Total Capital Bought	Sales (GWh/year)	Winning Consortium
DISTRIBUTION					
Ecselsa	385	11.78	50.00	5,487	Iven and GTD (Brazil)
Light	2,217	-	54.00	21,689	EDF (France) AES (USA) Houston (USA)
Cerj	588	30.27	70.26	5,733	Chilectra/Enersis (Chile) EDP (Portugal)
Coelba	1,602	77.38	62.54	7,985	Iberdrola (Spain) Previ (Brazil)
CEEE (Centre-West)	1,372	93.55	90.91	5,772	AES (USA)
CEEE (North-Northeast)	1,487	82.62	90.75	4,611	VBC (Brazil) CEA (USA) Previ (Brazil)
CPFL	2,741	70.15	41.06	16,704	VBC (Brazil) Bonnaire (Brazil)
Enersul	568	83.79	48.67	2,513	Ecselsa
Cemat	356	21.09	86.91	2,139	Grupo Rede/Inepar (Brazil)
Energipe	525	96.05	86.42	1,492	Cataguases-Leopoldina (Brazil) CMS (USA)
Cosern	616	73.90	85.75	2,084	Iberdrola (Spain) Previ (Brazil)
Coelce	868	27.20	53.11	4,778	Enersis (Chile) Endesa (Spain)
Eletropaulo Metropolitana	1,776	-	29.80	34,779	EDF/AES/Houston
Celpa	388	-	51.26	3,014	Grupo Rede/Inepar (Brazil)
Elektro	1,273	98.90	46.62	10,295	Enron Brazil Power Holding
Eletropaulo Bandeirante	860	-	29.80	23,170	CPFL/EDP

Table 11. Energy Consumption (1981-2000)

Source: Eletrobras

Year	GDP growth	Energy Consumption (GWh)	Change (%)	Installed Capacity (MW)
1981	-4.3	118,482	2.6	34,228
1982	0.8	125,439	5.9	36,181
1983	-2.9	134,180	7.0	37,186
1984	5.4	149,092	11.1	38,026
1985	7.9	164,088	10.1	39,874
1986	7.5	177,357	8.1	40,257
1987	3.5	182,565	2.9	42,663
1988	-0.1	192,738	5.6	44,402
1989	3.2	201,474	4.5	47,870
1990	-4.4	205,310	1.9	48,819
1991	1.0	214,429	4.4	50,707
1992	-0.5	218,425	1.9	51,698
1993	4.9	227,121	4.0	52,713
1994	5.9	235,627	3.7	54,117
1995	4.2	249,120	5.7	55,379
1996	2.7	260,111	4.4	57,199
1997	3.3	276,186	6.2	59,160
1998	0.2	287,392	4.1	61,327
1999	0.8	291,858	1.6	63,966
2000	4.2	306,300	4.9	67,700

Chart 1



Source: Eletrobras

Chart 2

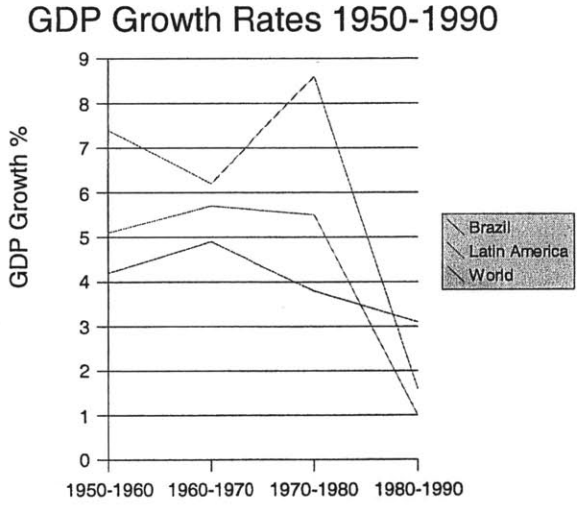


Chart 3.
Source: Banco Central do Brasil

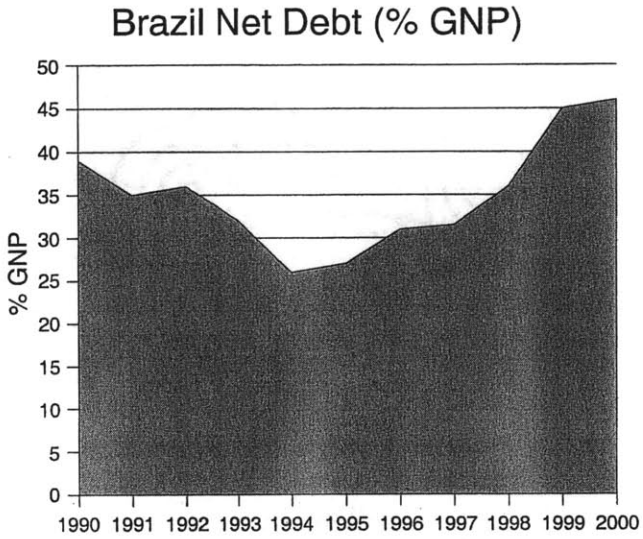


Chart 4.
Source: BNDES

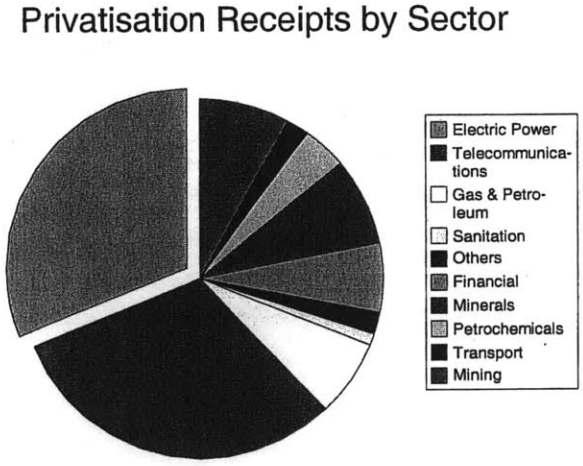


Chart 5.
Investments in Brazilian Electric Power 1980-1997
Source: Eletrobras

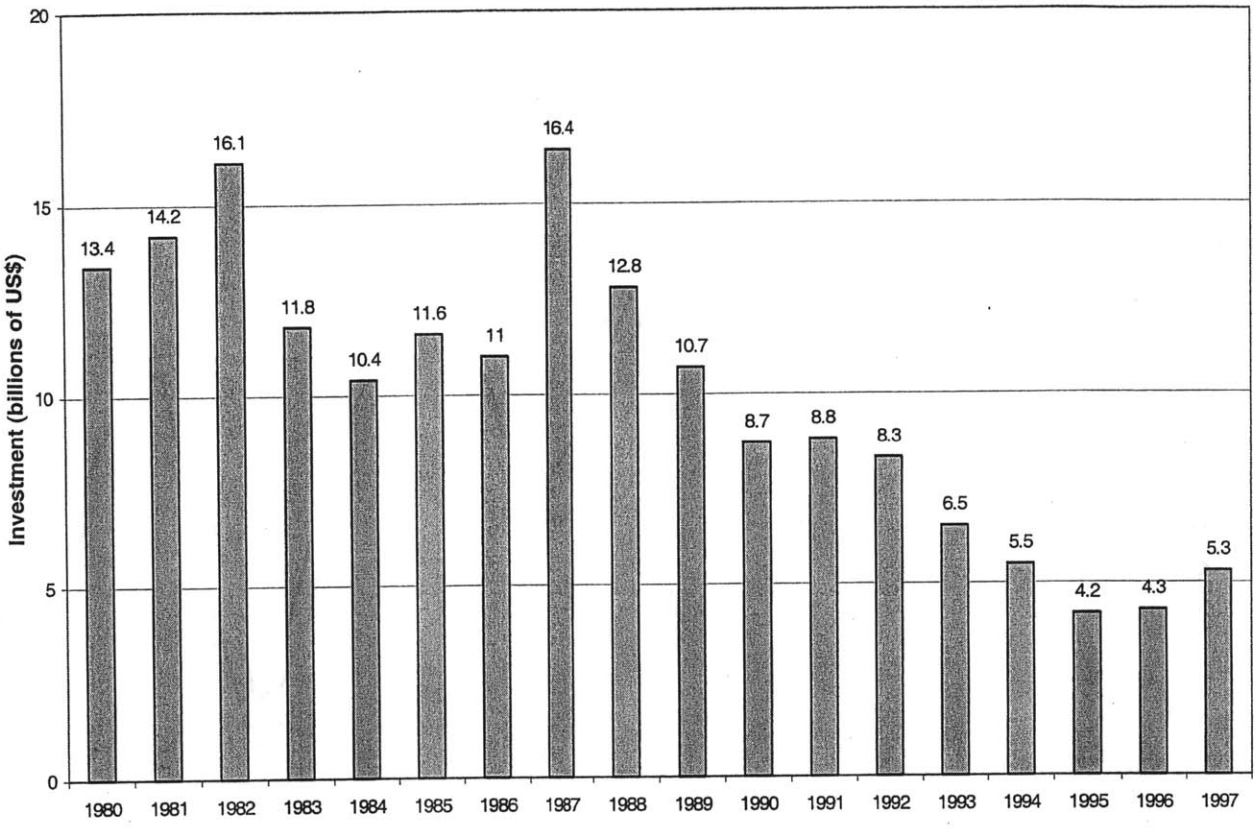


Chart 6.
Systems Centralwest/Southeast Reservoir Levels 1997-2001
Source: ONS

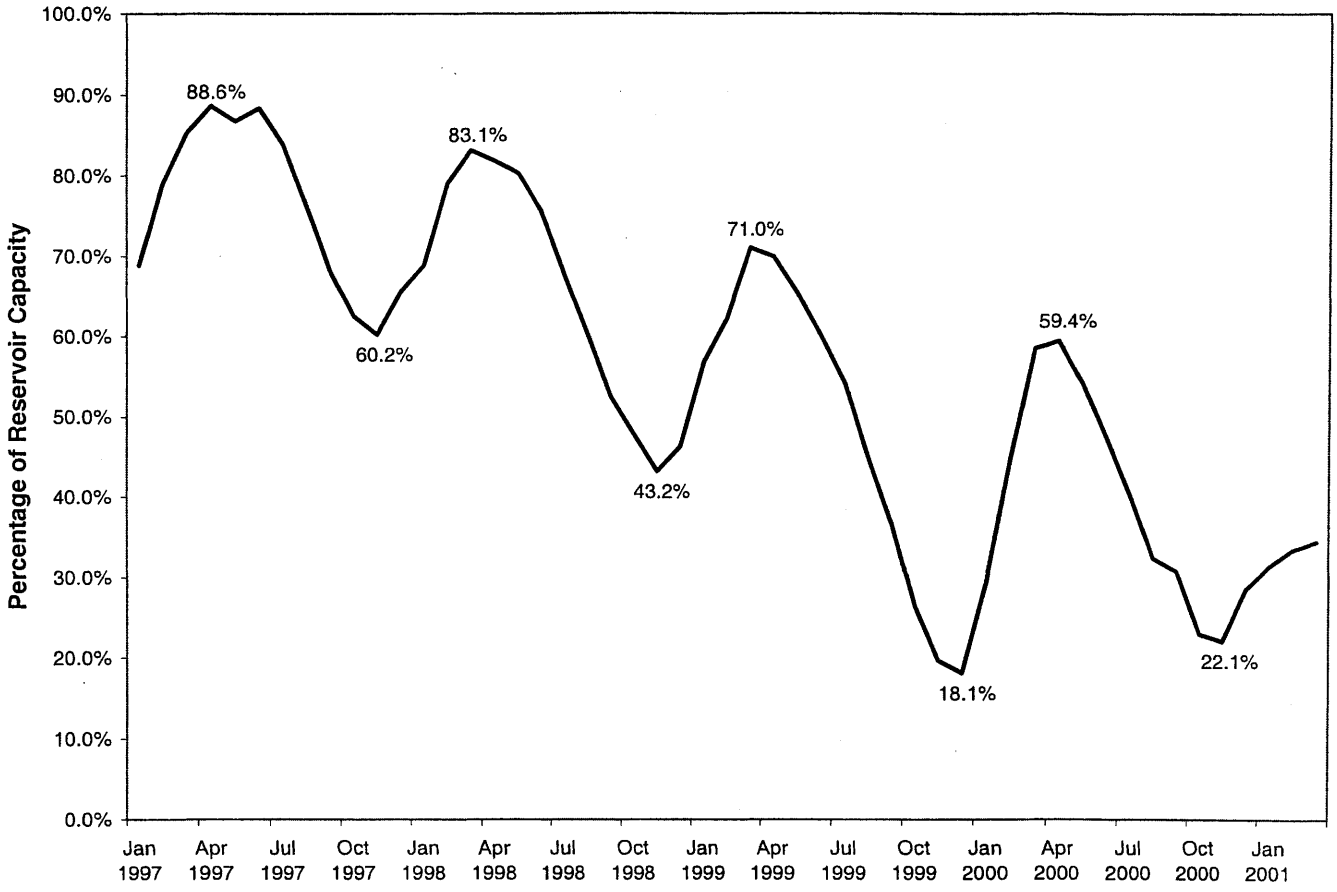
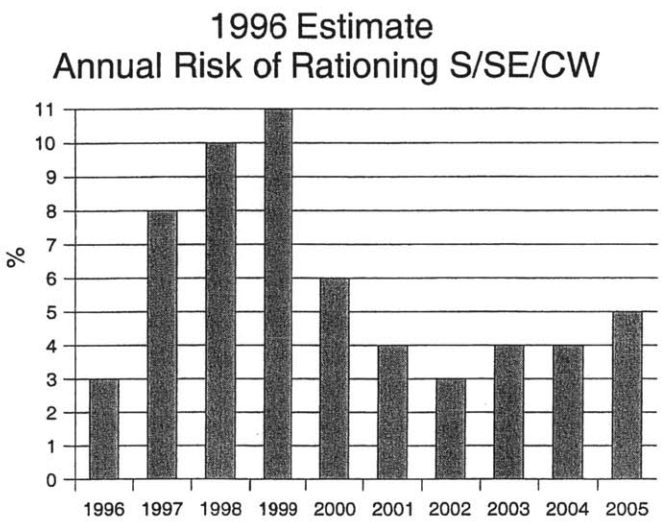


Chart 7

Source: Eletrobras Plano Decenal de Expansao 1996/2005



NOTE: The acceptable risk level in Brazil's hydropower system has traditionally been set at 5%

Paper Two

THE RISK OF REFORM
Analysing the Effects of Privatisation on Costs of Capital and Prices in the Brazilian Electric Power Industry

1. Introduction

In the 1990s, infrastructure privatisation was popular in Latin America. Reformers from within governments and development assistance agencies from outside championed privatisation with the claims that it would bring in the investment needed to expand infrastructure networks and the efficiencies required to make it affordable. They also argued for privatisation on the grounds that it would wean governments away from populist but not-remunerative prices for public services and that it would reduce corruption. For their part, investors, from mostly the industrialised countries, welcomed the opportunities that investor-friendly privatisation policies provided them to expand beyond stagnant home markets.

A decade later, infrastructure privatisation is much less popular. Both customers and investors are deeply dissatisfied, especially in capital intensive industries—electric power and water & sanitation, for example—where the fundamental technologies and industry structures have not changed substantially. On the one hand, consumers are complaining about high prices. In Brazil, as a first step towards privatisation the Franco administration passed a law in 1993 lifting the strict controls on electric power rates; in Buenos Aires, the Menem administration raised water charges by 25% in February 1991 and a further 29% in April of the same year, before auctioning a 30-year concession to private investors in 1993; and even in England, the government increased regulated power prices by 25% for residential customers and by 19% for industrial customers between 1989 and 1991 in what analysts believe was a bid to make the system more attractive for privatisation. These increases were justified by stating that they were necessary to provide a minimally remunerative rate of return to investors. On the other hand, investors are now complaining about insufficient returns. Rate increases after the initial increases have not been as generous to the private investors. Indeed, while privatisation had initially forced policymakers across Latin America to increase the charges for infrastructure services, investors are now complaining that these rates are no longer sufficient and that regulators are not passing through what they—the investors—would consider adequate rate increases.

One explanation for both consumers and investors are simultaneously dissatisfied with infrastructure privatisation that has been overlooked in most analyses is the impact that the reforms might have had on the costs of capital employed in these industries. Privatisation fundamentally changes the magnitudes and the distribution of the risks involved in infrastructure investment, particularly policy and regulatory risks. Infrastructure industries are particularly vulnerable to such shifts in the risk profile because they are typically capital-intensive ventures with long asset lives. If sectorial reforms do, in fact, increase the exposure of investors to policy, regulatory and market risks, thereby increasing the cost of the capital employed, and if such increases in the costs of capital are not compensated for by sufficiently large price and/or efficiency increases then investors may still feel under-compensated even if prices and/or

efficiencies are rising. With capital costs constituting a large part of total costs, risk, as it translates into the cost of capital, thus assumes a pivotal role in determining investor behaviour and the pricing of infrastructure services.

Privatisation proponents dispute that it increases the costs of capital and argue that in any case privatisation and liberalisation spur efficiency gains that offset the higher cost of private capital. The cost of capital of a project, they claim, is a function of its risk profile and changing ownership does little to change that profile. They admit that costs of capital could be lower in the public sector if it were more adept at managing project risks, but they claim that this is not the case.

In this paper, using the Brazilian electric power reforms as an empirical and illustrative case,[20] I discuss the opposing arguments about the relative cost of capital in the public and private sectors. The two principal empirical questions that this paper addresses are (1) whether privatisation raised the cost of capital employed in the Brazilian electric power industry and if it did (2) whether the efficiency gains realised through privatisation and liberalisation were sufficient to compensate for the increased capital costs. The theoretical problem that I tackle is whether private capital is really more expensive than public capital.

To address these issues, the paper presents two hypotheses: First, that if the costs of capital are large relative to operating costs then, unless efficiency gains are also very large, privatisation will lead to an increase in prices. Second, that the potential efficiency gains in the Brazilian power generation sector were low because of the dominance of hydropower in the energy matrix and because the state-owned generation firms were not that inefficient to begin with. To confirm these hypotheses, the paper presents data on post-privatisation efficiency gains in the Brazilian electric power industry and compares the costs of capital for public and private sector firms. After confirming the hypotheses, the paper will show that in infrastructure industries a positive relationship exists between the risks of privatisation as a reform strategy and the level of capital required in an industry.

The paper presents the theoretical concepts underlying this paper by discussing of the role of risk in determining the cost of capital and comparing public and private costs of capital. Empirical evidence related to post-privatisation costs of capital and efficiencies are presented in section III while section IV analyses and explains the root causes behind the shifts in the risk profiles of electric power investment in Brazil. Section V presents the core theoretical proposition of this paper—why public capital, in certain industries, may be cheaper than private

[20]The Brazilian electricity reforms explicitly illustrate the issues under consideration in this paper. Because of its economic weight in the region, what happens in Brazil is in itself important but what makes the Brazilian electric power reform case particularly useful is precisely the peculiarity of its electric power system, especially in terms of industry structure, which magnifies certain impacts that may otherwise be lost within the general noise accompanying policy research. For example, the dominance of hydropower in Brazil's electricity matrix emphasises the impacts of changes in the cost of capital because capital constitutes a much larger percentage of total cost in hydropower than it does in an electric power system dominated by, say, gas-driven thermal power plants. In addition, the fact that Brazil's hydropower system allows it to meet full demand for several years in a row even in the face of under-investment but then leads to a massive risk of under-supply accentuates the pitfalls of incorrect policy trends, precisely because it makes mid-course policy corrections unlikely. As the impacts of policy decisions are starker, they become easier to identify and study. The Brazilian case with its hydro-dominance is therefore not, as some scholars would argue, idiosyncratic but rather is one in which certain forces common to all infrastructure industries are amplified.

capital. Section VI evaluates the potential impacts of the Brazilian electric power reforms on prices and investment in the sector while section VII concludes with some recommendations for public policy.

2. The Role of Risk

2.1. Conceptual Background

It was Frank Knight who first suggested that profits and entrepreneurship were linked to risk and uncertainty and, indeed, formed the basis of the free enterprise system. Following Knight's proposal in his 1921 treatise on *Risk, Uncertainty and Profit,* other economists (Hicks 1931; Keynes 1936; Kakecki 1937; Makower & Marschak 1938; Stigler 1939; Tintner 1941; Hart 1942) also began to include risk and uncertainty into their analyses of investment decisions, financing, the size and structure of firms, etc. Later economists (Freidman & Savage 1948; Markowitz 1952; Arrow 1965; Rothschild & Stiglitz 1970, 1971; Diamond & Stiglitz 1974) built upon and formalised these ideas consistently throughout the 20th century. In 1944, von Neumann & Morgenstern introduced expected utility rules as the foundation for studying decision-making under risk, while Savage (1954) innovated with subjective (not mathematically expressed) probabilities in the place of objective (mathematically expressed) probabilities.

Risk, defined in layman terms, is the probability that the outcome of a venture differs from that which is desired. In economic terms, risk determines the opportunity cost of the capital. Projects that are more risky require higher payoffs and for an investment to be viable, its expected rate of return must be at least equal to the cost of capital *adjusted for risk.* Venture capital, for example, demands a high payoff to compensate for the high probability that the investment will yield little or no return. Treasury bonds of industrialised countries, on the other hand, receive low returns reflecting the very low probability that the investor will not be repaid. Consequently, risk can be treated as just another cost of doing business—like interest, wages, or rent—for which an investor would require remuneration.

Given their centrality to investment decisions, it is indeed surprising that analyses of risk and uncertainty have not figured more prominently in the study of infrastructure privatisation in developing countries. The privatisation literature is, instead, focussed overwhelmingly on efficiency issues, from both theoretical and empirical perspectives. On the theoretical side agency (Alchian & Demsetz 1972; Niskanen 1971), property rights (Alchian 1965; Demsetz 1967), and public choice literatures (Buchanan & Tullock 1962) have been marshalled to discredit government ownership as inefficient and wasteful. On the empirical side there is substantial confirmation of the theoretical predictions. Megginson & Netter's (1999) comprehensive survey of privatisation cites numerous empirical works which indicate that private and privatised firms outperform their state-owned counterparts and that privatisation generally leads to improvements in operational efficiencies. Other surveys have reached similar conclusions.[21] Indeed, the steady supply of empirical cases provided by the privatisation

[21] For other summaries of privatisation studies, see Tittenbrun (1996) and Villalonga (2000). Some contradictory evidence challenging the operational superiority of private over public firms does exist. For example, Kay & Thompson (1986) and Wortzel & Wortzel (1989) suggest that privatisation does not improve economic efficiency. An earlier study comparing the performance of private and public electric power companies showed that the government owned power companies in the United States were actually more efficient than their private

movement has kept scholars busy in comparing pre- and post-privatisation efficiencies to the neglect of other effects of ownership and regulatory changes.

In comparison to the voluminous literature on the efficiency effects of privatisation, its effects on risk and on the cost of capital have not generated a lot of polemic. Privatisation, intrinsically, shifts risks between the public and private sectors. The critical question—from the economic and policy reforms perspectives—is whether privatisation creates or eliminates risk or whether the aggregate risk remains constant and it is only the various component parts that are shifted between the public and private sectors. This obviously has major implications for the behaviour of prices during privatisation processes. If privatisation increases aggregate risks, it will result in a higher discount rate and tend to induce higher prices and vice-versa. If privatisation transfers risk, then the amounts and types of risk transferred and the relative costs of risk bearing between the public and private sectors will determine the impacts on prices and investment.

The theoretical literature on the issue is sparse, with the notable exception of some work performed over three decades ago, such as Hirshleifer (1965) and Arrow & Lind (1970), which compared and disagreed on public and private sector costs of capital. Arrow & Lind's article in the *American Economic Review* argued that governments enjoy lower costs of capital because they are able to neutralise risk by spreading it among a large population. While it was generally accepted and empirically verifiable that governments could obtain debt at a cheaper rate than could private firms and therefore could invest at lower discount rates, privatisation advocates, especially the monetarists, strongly objected to government investment on the claim that it was inflationary. They did not, however, dispute the claim that government finance costs are lower.

The debate was reopened recently when a 1997 issue of the *Oxford Review of Economic Policy* was dedicated to comparing private versus public costs of capital and its implications for public investment. Several articles in that issue (Brealey, Cooper & Habib 1997; Klein 1997; Grout 1997) took issue with Arrow & Lind's assertions. The orthodox pro-privatisation view argued in them is that the public-sector's advantage in raising cheaper capital is illusionary and stems from that fact that it does not remunerate taxpayers who are effectively providing it with credit insurance. These articles, and others, have also claimed that in any case, the cheaper credit available to governments is often offset by their inefficiencies and recommended that public and private projects should be evaluated at the same discount rates and that governments should redirect investment to the private sector by focusing on macroeconomic stability, deregulation and liberalisation.

While this advice has not yet been extensively operationalised, institutional efforts to promote it are strong. This policy advice goes counter to established infrastructure finance practices and, if adopted, would indicate not just a deeper commitment to privatisation but also fundamentally changing the way public finance works. Is this theoretically justified? To answer this question one really needs to understand better not just the risks involved in infrastructure development but also how to conceptualise them theoretically.

---

counterparts (Faere, et. al. 1985). However, such examples are rare and have not successfully challenged the popular notion that privatisation leads to increased efficiencies.

2.2. Is Public Capital really Cheaper than Private Capital?

Finance theory defines the risk of an investment as the correlation between the expected returns of an investment and the expected returns on the overall market portfolio (generally known as the β of an investment or asset). Analysts commonly use techniques such as the capital assets pricing model (CAPM) to determine expected returns, R, on an investment or asset, which is calculated as: $R = Rf + \beta(expected\ portfolio\ return - Rf)$, *where Rf is the risk-free rate.*

What approaches such as CAPM assert is that the real cost of capital for a particular project is a function of a project's risks and not the source of its financing. This is an important distinction between borrowing and investing which emphasises that the cost of debt relates only to the debtors' repayment abilities and not at all to the risk profile of the project for which the debt is being incurred. Thus, while governments need pay only the risk-free interest rates on the funds that they borrow, when that amount is invested in a project there is still an additional cost represented by the project risk, (which depends upon the project's design and which needs to be accounted for). Accordingly, pro-privatisation economists argue that both public and private projects should use discount rates based on the co-variance of project returns with those of investments on the market and consequently, that the opportunity cost of capital is the same for a particular project regardless of whether it is undertaken by the public or the private sector. It follows from this reasoning that in practical terms the difference between public and private investment is that the latter explicitly builds the price of the project's risk into the cost of capital whereas the former masks it.

Arrow & Lind (1970) explain how, in fact, the public-sector masks the effect of risk in a project as it goes about financing it. They start with the assumption that "individuals are not indifferent to uncertainty and will not, in general, value assts with uncertain returns at their expected values." As an extremely simplified example, we can imagine that individuals who are naturally risk-averse would, if given the choice, prefer to receive a guaranteed $1,000 rather than gamble on a coin toss to win $3,000 even though the latter option has a higher expected value (.50 x $3,000 = $1,500). Thus, they conclude that "investors do not choose investments to maximise the present value of expected returns, but to maximise the present value of returns *properly adjusted for risk.*" In general terms, therefore, for individuals the expected value of net benefits overstates willingness to pay by an amount equal to the cost of risk-bearing.

Given risk-averseness in individuals, Arrow & Lind ask "whether it is appropriate to discount public investments in the same way as private investments," and conclude that governments should, in fact, ignore uncertainty and behave as if indifferent to risk. They argue that a public investment is one in which each individual taxpayer has a very small share because governments have the unique ability to distribute the risks of an investment among the population of taxpayers as a whole. As the population becomes large, the individual cost of risk-bearing tends towards zero because the share borne by each taxpayer becomes negligible compared to his income and/or wealth. In this manner, by reducing each individual's financial exposure as a taxpayer to essentially zero, governments are able to eliminate the cost of risk-bearing so that the value of a public investment equals the expected value of that investment and not the expected value of the investment *adjusted* for risk. These results hold, Arrow & Lind show, even if the value of the investment and the costs of risk bearing are large in an absolute sense as long as the population and national income are sufficiently much larger in comparison.

For public investments, therefore, Arrow & Lind conclude that the cost of capital is cheaper than the cost of private capital by an amount equivalent to the cost of risk-bearing.

The counter-argument, anticipated by Arrow & Lind, is that the case of corporations where the number of shareholders is large would mirror the public sector where the population of taxpayers is large, i.e., in the former case also the total cost of risk-bearing for shareholders would be essentially zero. In such an eventuality, managers acting in the best interests of the shareholders should also ignore the cost of risk bearing while making investment decisions. However, in the case of a private sector firm, Arrow & Lind argue that the principal shareholders generally retain a large block of stock and for them this block represents a significant component of their wealth. They cannot, therefore, behave in a risk-neutral manner. Additionally, Arrow & Lind argue that the careers and income of managers are related to their firm's performance and, consequently, they too cannot afford to be neutral to risk.

Arrow & Lind's risk-spreading argument is conceptually different from portfolio diversification—an instrument available to private (and public) investors to reduce the volatility of their returns by investing in ventures whose outcomes are low or negatively correlated. Vickrey (1964) had argued that governments are able to diversify their portfolio and risks more cheaply than private investors because they automatically pool a number of different projects "without any cost of extra financial transactions." For Arrow & Lind it was essential for their results to hold that the government's portfolio of projects be diversified since otherwise the total costs of risk-bearing for all of the government's projects might well end up representing a not-negligible portion of each individual taxpayer's income but the chief benefit of public investment in their analysis arose from the ability to divide the cost of risk-bearing of each individual project among an extremely large population and not from reducing the transactions costs of portfolio diversification.

Klein (1997) is fairly representative of the several criticisms of Arrow & Lind's position. His basic argument is that if taxpayers were remunerated for the risk that they assume in public projects, then governments would not enjoy any capital cost advantage. He claims that governments effectively coerce taxpayers into assuming a contingent liability and therefore the apparent benefits of sovereign finance have no social value. In this manner Klein also explains why governments are able to raise debt more cheaply than the private sector. The cost of debt does not depend upon the project for which it is incurred but rather on the credibility of the debtor to pay back the loan. Government debt is cheaper because if the project fails it can always fall back on tax revenues to service the debt. In other words, taxpayers provide de facto credit insurance for government borrowing but since governments do not reimburse taxpayers for this credit insurance they enjoy a competitive advantage vis-à-vis the private sector. Klein goes on to argue that instead of using their ability to raise cheaper debt to finance infrastructure projects, governments should concentrate on making the typical and basic orthodox reforms—improving macroeconomic stability and the policy environment for private projects, and deregulating and liberalising the financial sector—in order to induce more private investment.

Grout (1997) takes a different approach to countering the claim that the public sector can fund projects more cheaply than the private sector. He shows that consumers have identical utilities whether a project is undertaken by the public or the private sector but his example rests on the assumption that everyone in the economy is a shareholder in the private sector, which is an assumption that appears untenable.

Another objection to the risk-spreading argument is the government portfolio is not, in fact, sufficiently diversified. Many public projects are concentrated in a narrow range of activities and are often large as well as markedly correlated with national income. The returns from investment in infrastructure, for example, are highly correlated with national income (and this correlation stands regardless of whether it is undertaken by the public or the private sector). Consequently, there remains on balance an element of undiversified risk and so the entire portfolio of government investment may well burden heavily the individual taxpayer.

This was the view that was, in fact, articulated by an Australian government task force on private infrastructure that rejected the contention that the public cost of capital is cheaper than the private cost (Economic Planning Advisory Commission 1995).[22] The immediate policy advice that follows is, of course, that risks should be discounted in the same way for the public as for the private sector.[23] Indeed, Hirshleifer (1966) had urged this position many decades ago when he cautioned against the use of a lower rate of discount for the public sector. His chief concern appeared to be that given a finite amount of capital available within an economy, governments might choose to invest in projects which would be profitable only when returns are evaluated at the government's low borrowing rate, thereby leading to the displacement of higher-yield private investments by lower-yield public investments. He recommended that instead of evaluating public investments differently from private ones, the government should borrow cheaply and then subsidise the higher-expected-yield private investments.[24]

Criticisms of Arrow & Lind's propositions are accurate to the extent that even in the case of public financing someone—i.e., the taxpayer—has to bear the project risk, which in absolute terms is non-zero. However, Klein (1997) is not completely accurate in claiming that when public investments are undertaken, it is at the expense of the taxpayers who are being coerced into providing credit insurance and thus economically exploited. Since public sector projects are generally undertaken for the public benefit and the lower costs of capital are usually passed on to the public in the form of lower prices for public services such as electric power and water & sanitation, it is hard to argue that public sector investment at lower costs of capital represents coercion and exploitation. Indeed, the very definition of the populist politician would appear to be the one who, in Klein's view, does the most coercion and exploitation.[25] Lower prices are, in fact, the compensation taxpayers receive for guaranteeing the public debt and the privatisation exercise can be conceptualised as an exercise in reducing public risk in exchange for paying higher prices for public services.

One could argue that public ownership is an inefficient form of compensation for risks borne by the taxpayer. Some taxpayers may end up bearing the risk for a service—a hospital or a road in a different city for example—which they do not use. However, on an economy-wide basis, this might well average out since governments generally construct hospitals, roads and the

---

[22] The Task Force's report is quoted in Klein (1997). I have relied on the author's quote.

[23] I ignore the taxation issue here. For readers interested in the issue, I recommend pages 21-22 in Brealey, Cooper & Habib (1997) and page 269 in Hirshleifer (1966).

[24] Interestingly, this was exactly what the Brazilian National Development Bank (BNDES) did during the country's electric power privatisation process when it extended subsidised credit to private power sector investors.

[25] Empirical evidence would also counter the argument that the populist politician exploits the rich, since infrastructure services in developing countries go mostly towards the privileged classes, while the poor are often excluded from the networks and have to self-provide.

like throughout the country.[26] Moreover, for the purposes of this paper, which deals with the electric power industry, it would not be a stretch to assume that the entire population does in fact partake of the service.

So, the argument reverts to the question of efficiency. If the government has no real advantage in raising cheaper capital and merely compensates citizens for their contingent liabilities in the form of cheaper public utility prices then in real terms it is irrelevant whether it is the public or the private sector that invests in infrastructure. Privatisation advocates would then claim that if the cost of capital is the same for both sectors then society would gain through privatisation since the private sector is more efficient than the public sector. Dissenters might then rebut by claiming there is no a priori reason why privatisation would deliver efficiency gains, that efficiency depends more on market structure than ownership (Vickers & Yarrow 1991), that public ownership pursues worthwhile goals other than profit maximisation, and that, in fact, empirical evidence does exist that shows that after controlling for cost of capital and other factors in some cases public companies have been more efficient than private ones (see, for example, Faere, et. al. 1985). These objections are, however, overwhelmed by the numerous of empirical studies that do judge in favour of private enterprise.

In the general case, therefore, the preponderance of evidence supports the pro-privatisation view. Arrow & Lind's reasoning applies not just to infrastructure but to all industries—industries that are monopolistic and those that are competitive, industries that deal with public goods and industries that deal with purely private goods, industries that are economically strategic and ones that are not. Their reasoning, however, cannot stand up to either modern finance theory or empirical observation. In the vast majority of industries governments could arguably apply cheaper sovereign finance, but their cost of capital would be lower not because they are more efficient at dealing with and dissipating risk but because of what Klein terms their coercive power over taxpayers. In competitive industries, like bicycles for example, governments could try competing with the private sector to test out theories of ownership and efficiency but we would be hard-pressed to find anyone seriously proffering that opinion. Privatisation and private finance thus appears to be a robust policy recommendation on theoretical grounds. Empirical observation of the Brazilian electric power reforms, however, raises some doubts on this score.

3. Empirical Observations on Post-Privatisation Costs of Capital and Efficiency

The Brazilian electric power reforms lasted seven years, from 1993 to 2000. Privatisation began in 1995 and virtually ground to a halt in late 1998. Direct observations on actual rates of return during this period are both difficult and potentially misleading. In the general case, immediately before privatisation prices may be increased substantially (as an incentive to potential purchasers) but efficiency improvements may lag, large and immediate investments may be necessary and some firms might make them while others might prefer to follow a "profits now investment later" strategy, and there may also be a period of learning involved as new operators take over the infrastructure. All of these factors may contribute to an incorrect interpretation of the data on costs, efficiency and returns. In the specific case of Brazil, analysing rates of return are complicated by additional factors. Most prominent of these additional factors was the

[26]In making this claim, I reluctantly but perforce assume away the very real problem of unbalanced infrastructure service provision that has been empirically identified in many, especially developing, countries.

devaluation in the beginning of 1999 during which the Brazilian currency lost 40 % of its value. Electricity rates, which were denominated in the local currency (as expressly required by the Concessions Law), remained stable while concessionaires' costs, especially their debt service payments which were linked to hard currencies, shot up. As such, profitability and rates of return plummeted even though the operational results in terms of the local currency remained strong.

Given the brief period under consideration, the unavailability of critical data and the as-yet-incomplete and anything-but-smooth transition from state owned to privatised, it would be misleading to attempt performing a statistical exploration of rates of return, costs of capital or efficiencies. However, the available quantitative data supplemented with qualitative data does provide an indication of certain trends in the cost of capital and efficiency in post-privatisation Brazilian electric power. I present this limited evidence below and use it not as proof of my subsequent theoretical arguments but rather as an illustration of the issues involved.

3.1. Cost of Capital

Electric power reforms and privatisation tended to push up the required rates of return in the Brazilian electric power industry. Before 1993, electric power investments were governed by the 1934 Water Code which limited rates of return to a minimum of 10 % and a maximum of 12 %. The 1993 Tariff Disequalisation Law did away with specific controls on rates of return, freeing electric power companies to establish rates that reflected both the cost of generation and an (undefined) "adequate" rate of return on capital investments. The subsequent 1995 Concessions Law repeated this provision by stating that the electric power regulator would establish electricity rate so as to guarantee the economic-financial equilibrium of the concessionaire, meaning that electricity rates should be high enough to theoretically enable the concessionaire to obtain financing for needed investments and expansion.

What was this adequate rate of return? Data released by the Brazilian electric power regulator, ANEEL, during its distribution company tariff review processes provide some indications. For distribution companies, ANEEL (2001) estimated equity costs at 17.47 % per annum. ANEEL used the standard CAPM and included exchange rate, regulatory and sovereign risk in its calculations of both equity and debt costs. Dissatisfied with ANEEL's estimates, the distribution companies contracted a consultant who estimated equity costs at 21.60 %, arguing that ANEEL had under-estimated exchange rate and regulatory risks as well as the betas of Brazilian electric power firms.

The consultant's report echoed my own qualitative data based on interviews with electric power executives, which indicated that private investors were looking to make about a 20% return on equity. Similar interviews with executives of state-owned power firms revealed a much lower demand for equity returns, in the region of 10%. However, in calculating costs of capital for distribution companies, ANEEL did not distinguish between privatised and state-owned firms. Instead of calculating the WACC for each firm separately ANEEL created a "model firm" and argued that the most efficient distribution of capital would be 50% debt and 50% equity.

Generation company rates of return were not regulated given that wholesale power prices would be set by the market after the expiration of the initial power supply contracts (from 2003 onwards). However, for generation companies, a government commission established to manage the electric power rationing estimated equity costs at 18% (CGE 2002).

Increases in the cost of equity were mirrored in the cost of debt. On the distribution side, ANEEL (2003) had estimated distribution companies would need to pay about 15.76% for foreign exchange loans. A previous ANEEL (2001) study indicated that privatised distribution companies paid an average of about 17% on debt papers they issued in the Brazilian markets in 2000 and 2001. State-owned firms paid much lower rates. Eletrobras, for example, paid an average of 7.8% on its US$ 8.2 billion debt in 2000, while Furnas paid between 6% and 12% on debts in the local currency and between 3% and 8.8% on debts in foreign exchange. In the meantime, Eletrobras charged a subsidised 10% plus inflation on loans it extended to AES-Tiete and Parapanema, two of Sao Paulo's privatised generation companies.

To conclude, on a nominal basis, both equity and debt costs for privatised Brazilian power firms were almost twice those of their state-owned counterparts. For the moment, this analysis does not address the issue that subsidised equity and sovereign finance may be at the root of this seeming advantage in capital costs that state-owned firms enjoy. I will address this issue in Sections IV and V.

3.2 Efficiency

The strongest argument for privatisation is that it encourages and realises operational and investment efficiencies. According to the residual claimant theory (Alchian & Desmestz 1972), the critical distinction between public and private ownership is that private principals operate under a strong incentive to increase efficiencies and reduce costs because they earn profits. Although the incentive to increase efficiency operates even in the absence of liberalisation, many scholars criticise the mere transformation of public into private monopolies asserting that it is unlikely to bring any real benefits to consumers (Clark & Pitelis 1993; Vickers & Yarrow 1991). In such cases, regulation, especially of the incentive-based type, can serve as a surrogate to competition, driving efficiency gains as well as providing a means to share gains with consumers. Deregulation and liberalisation ought to spur even greater efficiency as firms seek to gain competitive advantage, with the added benefit that the consumers can benefit in economic terms from the inter-firm competition.

Empirical evidence does indicate that privatised Brazilian firms did increase operational efficiencies but these gains were not restricted to privatised firms nor did they commence with privatisation. In fact, Brazilian power firms began to reform and become more efficient more or less after the commencement of the industry commercialisation process in 1993. Many of them began by dismissing hundreds of workers, continuing a process that had already been initiated under the National Voluntary Retirement Programme while the firms were still under state control. Coelba, for example, trimmed its workforce by 40% even before it was privatised. After privatisation, some distribution companies began to aggressively tackle power losses and thefts. Performance indicators, such as unplanned power cuts, also improved over pre-reform levels.

In the case of distribution companies, between 1993 and 1996 (by which time only three out of 17 major distribution companies were privatised) the average MWh sold per employee increased from 1,231 MWh to 1,844 MWh (see Chart 2), indicating that efficiency gains commenced prior to privatisation. In terms of efficiencies, privatisation also demonstrated some perverse trends. Between 1993 and 1997, supply interruptions on average decreased from 26.32 hours per year to 24.52 hours per year (see Chart 3), but for the privatised distribution companies

supply interruptions increased (from 13.20 hours per year to 16.59 hours per year for Light and from 34.07 hours per year to 47.86 hours per year for CERJ), indicating that cost-cutting measures could be having a negative impact on the quality of service. Similarly energy losses for the industry in general remained stable between 1993 and 1997 averaging 13.2% in both years but increased for Light (14.4 to 16.1%) and CERJ (18.6 to 25.3%). These performance indicators improved only after 1997 following the establishment of the electric power regulatory agency, which began to impose stiff fines on errant distribution companies.

The vertically integrated firms, none of whom were privatised, also became more streamlined and productive. Cemig, for example, cut its payroll by over 5,000 employees between 1993 and 1997. Overall, employment in vertically integrated firms fell from a high of 62,200 in 1994 to 36,800 in 1997 while MWh sold per employee increased from 1,902 MWh in 1993 to 3,573 MWh in 1997 (see Chart 2). Supply interruptions were also reduced, from an average of 26.19 hours in 1993 to 21.02 hours in 1997. Energy losses increased marginally from 7.3% in 1993 to 8.1% in 1997 (see Chart 3).

On the generation side, we can compare the operational performances of Furnas, Chesf and Gerasul (formerly known as Eletrosul), the first two remaining under federal ownership and the last being privatised in 1998. Between 1993 and 2000, data collected from the firms indicates that Furnas and Chesf reduced their operational costs per MWh sold by 5% and 3% respectively. Meanwhile, Gerasul, reduced its operational costs by about 10% per MWh. Thus, increases in efficiency were not restricted to only the privatised firms. For example, data from federally-owned Furnas indicates that the company reduced its workforce from 7,094 in 1995 to 5,216 in 1997 and even further to 3,846 in 2000. During the same period, its sales increased from 97.7 TWh in 1995 to 111.3 TWh in 1997 to 152.4 TWh in 2000.

To summarise, the data shows that Brazilian electric power firms did become more efficient after privatisation, but the data also shows that firms began to increase their efficiency before they were privatised and even those firms that continued under state ownership also became more efficient. It is therefore unclear what role privatisation played in increasing efficiencies in the Brazilian electric power sector. It appears that efficiency gains have resulted more from preparing the industry for privatisation by loosening policy and regulatory controls during the commercialisation phase (as discussed in Section 3.1.1.) than from the change in ownership itself.

4. Explaining Post-Privatisation Risks in Brazilian Electric Power

The principal focus of Brazilian electric power reforms was on privatising and shifting the responsibility for investment from the public to the private sector. As this responsibility shifted, so too did the incidence, allocation and compensation of sector risks. In the process, risk was not simply transferred from the public to the private sector, but rather some old risks were eliminated and some new risks were created. Other risks were transferred, but not always completely. Even their magnitudes changed. In addition, many risks, which were always present but not accounted for, began to be explicitly considered by the private investors.

At the outset it should be recognised that even if no new risks had been introduced, privatisation by itself would have increased, nominally at the very least, the cost of capital and

discount rates employed in the industry. Private firms generally borrow at higher rates of interest than do governments. More importantly, the introduction of equity, which is inferior to debt and must be compensated at a higher rate, further increases costs of capital for private firms with respect to their public counterparts because governments generally demand a much lower return on their equity than do private investors. Empirical verification of this effect is already available from studies of the British utilities privatisation process. According to Newbery, the target rate of return for British power firms was raised from 3% to 6% *in preparation for privatisation.* Similarly, New Zealand's electric power utility increased its rate of return on equity from 4% to 12% in the five years following its corporatisation and preparation for privatisation (Culy, et. al. 1996).

Based on the theoretical discussions of Section II, risk shifting can explain at least part of the apparent advantage of public over private capital, especially as far as the cost of debt is concerned. In the strict economic sense, this advantage is illusory because it results from taxpayers as investors bearing higher levels of risk in exchange for enjoying lower utility rates as customers.

This reasoning, however, does not preclude the fact that the risks for public and private investment may indeed have been different. Indeed, in the following pages, I will show that the electric power reforms introduced new risks into the electric power industry and the introduction of these risks helps explain some of the movement in the costs of capital.

Typical risks in infrastructure projects include political risks (such as expropriation, currency inconvertibility and non-transferability), regulatory risks (such as taxes and changes in environmental protection laws), quasi-commercial risks (such as that a private investor will contract with a public body that may renege on its commitments), commercial risks (such as demand, default by customers and construction cost variability) and exchange and interest rate risks (Irwin, et. al. 1999). Commercial, exchange rate and interest rate risks affect public and private firms equally. Policy, regulatory and quasi-commercial risks, however, have differential impacts on public and private firms.

4.1. Policy Risks

An immediate consequence of privatisation was that it greatly reduced government interference in the operational and pricing decisions of the power companies. Various federal and state administrations had interfered liberally in the past, especially during periods of economic crises, when the power firms were especially vulnerable. To stem inflation, the federal government had instituted price controls which resulted in massive falls in real electricity rates and subsequently in investments; to promote industrialisation in backward areas, the federal government had mandated a uniform rate for the entire country; to access foreign loans during the credit crisis of the 1980s, both state and federal governments had forced power companies to take loans in the international markets and then had diverted the funds to pay off their own creditors. Furthermore, politicians at both federal and state levels also leveraged their control over power firms to exercise patronage. All of these policy interventions contributed to weakening the financial and operational health of the power companies and it was such negative influences that the reformers were seeking to eliminate through privatisation.

Privatisation reduces policy risk inasmuch as it diminishes the government's ability to exert such control over the commercial operations of a firm, but it does not by any means eliminate the temptation for the government to interfere actively in the sector. The source of such temptation and the associated policy risk is the fact that infrastructure industries suffer from the problem of incomplete contracting and asset specificity. Infrastructure assets have long lives and as a practical matter it is impossible to predetermine future costs, prices, technologies, services, etc. Consequently, some degree of flexibility in the regulatory contract is both necessary and desirable. Wherever there is flexibility, there is always the temptation and the space and for opportunistic behaviour on the part of the government (or for that matter, even the private operator), especially when—as Vernon (1971) described in his obsolescing bargain theory—the political opportunity cost becomes higher relative to the economic and/or political benefits brought by the private investor. Meanwhile, the investor remains particularly vulnerable because his investment was expensive, and his assets durable and quite immobile.[27] As Gomez-Ibañez (2003) explains it, the problem of reducing policy risk is one of establishing a commitment to a stable set of rules governing the relationship between the government and the private infrastructure provider. Inflexible regulatory contracts can diminish this risk by making the rights and obligations of the various parties clearer but they cannot eliminate this risk. In addition, for long-lived projects like infrastructures, inflexible contracts are neither feasible nor desirable. In the first place, it would border on the impossible to predefine all the contingencies of such long-lived contracts. In addition, in some cases, inflexibility might itself contribute to a more complete breach of contract if it becomes too expensive for one party to continue complying with contract provisions. Flexibility, on the other hand, may allow for a more mutually beneficial renegotiation.

The bottom-line of these risks is that a government might, in the future, expropriate a firm (through nationalisation) or its earnings and/or profits (through regulatory and exchange rate controls). In the Brazilian context most analysts agree that outright nationalisation is very unlikely in the short and medium terms and can, for the purpose of this analysis, be ignored. Other, more subtle forms of expropriation are, however, much more likely. Indeed, the risk that the government through the electric power regulator might seek to suppress prices and thereby expropriate revenues is not insignificant in the Brazilian case.

The fear of policy uncertainty is not a risk in the strictly Knightian sense in that there is no effective way to assign a mathematical value to it, but as long as governments cannot credibly commit to refraining from intervening, private investors will continue to discount their expected returns to compensate for this risk. Despite the limitations in accurately gauging policy risk, my interviews indicate that investors were looking for an additional 2% to 3% return to compensate for the policy risks. Meanwhile, a study by the Brazilian Chamber of Energy Industry Investors (2004) estimated that policy risks in Brazil added at least 1.5 % to the discount rate.

4.2. Regulatory Risks

Policy risks are related to conscious government actions that expropriate investor earnings by opportunistically changing the rules of the game. Regulatory risks are related to the character of the regulatory institutions and how they might adversely impact investor returns

[27] Some investors have attempted to get round the immovability of electric power assets by mounting thermal plants on huge barges which can be towed away if the regulatory commitment is found wanting. It is an ingenious solution with obviously limited applications.

without changing the framework of the rules under which the game is played. Regulatory risk is therefore not derived from official government policy but is an outcome of the design and normal functioning of the regulatory institution.

From the regulatory perspective, the Cardoso administration's decision to change the system for regulating distribution monopolies from cost-of-service to incentive-based regulation changed the profile of regulatory risk industry. These risks were different from the policy and regulatory uncertainty discussed above and stemmed from the fact that, according to the 1995 *Concessions Law*, the federal government would not guarantee returns on investment. Eschewing the rate-of-return regulations under which Brazilian power companies operated ever since the enactment of the 1934 Water Code,[28] the Brazilian government chose to follow the British model of price-cap regulation. This model of utility regulation, commonly referred to as the RPI-X system, where RPI (Retail Price Index) is basically an inflation index, establishes a price-cap which is first adjusted for inflation (in order to maintain real tariff levels) and then re-adjusted by an X factor that functions as a proxy for expected efficiency gains that the utility operator ought to obtain and must pass on to consumers. Under this system, firms that are more efficient than the regulator expects will be able to earn a higher rate of return on their investments while those that under perform would be penalised with lower rates of return. This system therefore provides stronger incentives for firms to pursue efficiency but it also introduces the risk for the firm that it might not be able to achieve the levels of efficiency established by the regulator as well as the risk that the regulator might confiscate revenues through progressively higher X-factors.

In addition to the risk that the concessionaires might not achieve the required level of efficiency gains, the government also absolves itself from compensating for unexpected changes in the concessionaires' markets. Since distribution revenues are greatly dependent on total consumption, negative changes in total market demand could have a big impact on returns. Under rate of return regulation, the government would have been obliged to compensate for demand changes by raising rates but under price-cap regulation, there is no such obligation.

In a recent revision of distribution company tariffs in Brazil, ANEEL explicitly recognised this regulatory risk and estimated it as the difference between the β of US electric power firms that are regulated under cost-of-service rules and that of UK power firms that are regulated under the RPI-X system. In ANEEL's calculations, the difference was estimated to be 3.3%. Brazilian distribution company investors were, however, dissatisfied with this estimate. They protested that in view of the weaker Brazilian institutions (and the greater degree of asymmetric risk), the regulatory risk was being underestimated and should, instead, be set at 6.18% (Tendencias 2003).

However, the main risk from such incentive-based regulation, which was not contemplated by ANEEL, is that it is discretionary and as such it introduces an asymmetry of risk for the investor. While not a theoretical certainty, there is substantial empirical evidence that regulators are more inclined to control excessive profits than they are to compensate firms in case of excessive losses. In other words, rates are stickier on their way up than on their way down. This is especially true in developing countries given their greater sensitivity to increases

[28] The 1934 Water Code guaranteed power companies a minimum 10% rate of return on assets. In practice, the guaranteed was rarely honoured for the state-owned companies.

in electric power prices, especially in the political context, and more so when the relevant investors are not domestic but foreign.

5. Re-Conceptualising Policy and Regulatory Risk

If finance theory argues that the risks of a project depend upon its commercial characteristics and not upon who owns and finances it, how then do we reconcile the public versus private sector differences in costs of capital and required rates of return in the Brazilian electric power industry? There is no evidence that indicates governments might be better at dealing with commercial risks than private firms and at least some evidence to the contrary, so public capital should be at least as expensive as private capital. On the issue of policy and regulatory risks, it could be argued that both public and private firms would need to account for them since they are equally subject to it and as organisations equally damaged by it. For example, if a government forces unremunerative rates on electric power firms, both public and private firms will see their earnings fall and so both should use similar discount rates. The orthodoxy itself tends to ignore policy and regulatory risks in cost of capital calculations, generally arguing that governments should bear these risks. In other words, policy and regulatory risks should be treated only as exogenous undesirables that governments should seek to eliminate from the equation as quickly as possible. Both of these claims are flawed.

On a superficial level, the public sector firm, especially if it has a soft budget constraint, is indifferent to policy and regulatory expropriation of its earnings. The public-sector manager would prefer cost-covering rates because otherwise routine maintenance and service expansion become logistically difficult but on a fundamental level neither the manager's pecuniary remuneration nor career prospects are affected by the firm's financial performance. For investment, the government has the choice to finance projects through the firms' retained earnings (in which case the government would have to set rates high enough) or through transfers from general revenue sources such as taxes (in which case it would have to set taxes high enough) or even through loans taken on the basis of anticipated tax revenues. The decision as to which rates to set and how to finance investment will depend on the government's political and policy priorities and objectives. A government may prefer to institute higher user charges rather than fund a venture via tax revenues because of productive and distributive efficiency concerns but might still find itself unable to raise user charges because of political reasons. These are strategic decisions that policymakers have to make but since in the ultimate analysis it is the citizen that pays, either through user-charges or through taxes, the government as owner-investor is passively indifferent as to where the money comes from as long as the sum of user charges, tax revenues and anticipated future tax revenues proves sufficient. Of course, there is no guarantee that future tax revenues—often based on optimistic assumptions of economic growth—will prove sufficient and, in fact, many Latin American governments have found their predecessors have saddled them with infrastructure related debts that they found difficult to repay.

Privatisation, therefore, is not about whether the government wants the firm to set user charges at a level sufficient to cover costs (including capital costs) or at a level that requires transfers from general present or future tax revenues. It has been argued, correctly, that if the government wishes to implement low user charges then it would, barring few exceptions, be productively more efficient to privatise and provide the subsidy directly to the private operator. Indeed, like their public sector counterparts, private investors too would be indifferent to whether

the government pays them a subsidy or allows them to set adequate rates for their services. The relevant question in this debate about risks is not how government subsidises but whether the government will behave opportunistically once the private investment is made and renege on its commitment, forcing low rates on the private operator while not passing on the subsidy payments.

Arguing on the principles of risk allocation—that risks should be allocated to those who have the most control over the risk and those who can bear the risk at lowest cost—some privatisation advocates have called for risks related to government policy and regulations be borne by the government itself (Irwin, el al. 1999). They tend to categorise policy and regulatory risk in that category of risk which the government is better suited at managing. The reasoning behind it is simple: Governments are the source behind policy and regulatory risk and so they are best able to deal with it. Governments should, therefore, provide the private investor guarantees that they will be compensated if regulatory or policy changes work against the investors' interests.

This reasoning, unfortunately, is rather tautological and misses the real nature of policy risk. Including in the privatisation procedure the conditions under which investors would have the right to recourse merely defines the contractual environment. It does not prevent the government from behaving opportunistically in the future nor does it assess the probabilities that the government will honour in letter and spirit the nature of its commitments to the private investor. Policy risks are therefore additional to contractual guarantees. As mentioned in the previous section, the contractual relationships that are meant to define rights and responsibilities are by nature incomplete and government enjoys a wide range of policy instruments with which to circumvent them. If government really intended to compensate investors for changes in policy then they would be unlikely to implement the policy changes in the first place. The fundamental point about policy risks is that the government may not honour its commitments in the future. Indeed, orthodox economists admit that the main issue is "how the government can credibly commit itself to bearing the risk" (Irwin, et. al. 1999) but then generally skirt the issue, offering only that "obtaining this commitment may involve approaching an agency such as the Multilateral Investment Guarantee Agency (MIGA)." Investors may, if they so choose, insure themselves against risks to their well-defined rights but then, in the first place, it would, by definition, be difficult to purchase insurance for the incomplete parts of the contract and, in the second place, the costs of such insurance would make private projects more expensive than their public counterparts thus approximating the same effects as a change in the costs of capital.[29]

Given that the source of the policy risk is government's refusal to honour previously made commitments combined with investor lock-in due to asset specificity, a more accurate way to conceptualise such risks is to adopt a transactions cost framework. Coase (1937) applied transaction cost economics to solve the puzzle as to why firms emerge in the first place. He concluded that there are costs of using the price mechanism and the main reason for the existence of a firm is to reduce the cost of procuring inputs and intermediate products. In other words, there are costs associated with the procurement process that make it cheaper for a firm to bring an activity in-house even though an outside supplier enjoys higher levels of productive efficiency. Other economists (Masten, Meehan & Snyder 1989; Monteverde & Teece 1982; Teece 1983) applied this reasoning to organisational issues such as determining when and why

[29] Because of pooling effects, it might be cheaper to purchase insurance rather than have the risks reflected in the costs of capital, but the general analysis still holds.

firms would choose to integrate vertically or expand internationally but it was Williamson (1975, 1979, 1991) who did the most to develop transaction cost economics to explain the trade-off between markets and hierarchies. Williamson (1979) argued that transaction costs in intermediate-product markets depended upon the level of asset specificity and explained that unspecialised items presented few hazards to buyers or sellers since the former could easily source from alternative suppliers while the latter could sell to other buyers without difficulty. In the case of specialised physical capital, on the other hand, there is a symmetrical lock-in effect: buyers cannot turn to other sources of supply and neither can suppliers sell to other customers.

Under this framework, we imagine the government not as a regulator or policymaker but instead as a producer of services for the general population. In other words, the decision that the government faces is the classic "make or buy" decision that is treated under the transaction costs literature.[30] Let us now assume that the government decides that it is cheaper to buy than to make, i.e., to privatise. What privatisation does is that it converts a vertical relationship governed by hierarchy (descending from the level of the politicians to the operational staff of the public sector firm) to a horizontal market relationship governed by contracts between the private investor-operator and the government. For the government, buying rather than making will undoubtedly increase productive efficiencies, since that is the point of privatisation, but at the same time privatisation will create not only the costs of setting up the governance structures or institutional frameworks within which the transactions will take place but also the policy and regulatory risks stemming from government opportunism. In this case, the policy and regulatory risk represents costs to the investor of enforcing—or not being able to enforce—the contractual relationship between it and the government.[31]

Using this framework, we will see in the following analysis that it is not only incorrect to avoid including policy and regulatory risk in the cost of capital calculations but also that these risks are context-specific. An implicit trade-off is made during privatisation: higher productive efficiencies accompanied by higher transactions costs and, as WilliaImson (1979) stated simply, the objective must be to minimise the sum of production and transaction costs.

The weakness of most existing empirical studies of privatisation is that having proved the former (productive efficiency realised through privatisation), they proselytise on the latter. That governments should state their policies clearly and commit to them by instituting rules that make it difficult for current or subsequent administrations to renege on commitments to investors is clearly normative reasoning. While few would dispute that that is exactly what governments should be doing, there is no reason to expect that governments will, in fact, do so. The whole concept of policy risk rests upon the fact that governments will, if it suits them, opportunistically

---

[30]It may not be immediately obvious the electric power industry fulfils Williamson's conditions of asset specificity. In a liberalised market, electricity suppliers may sell to many potential buyers and customers also have a choice of suppliers with whom to contract. But, absent a liberalised market, we can see how quickly the industry structure migrates to asset specificity. The suppliers have made investments in generation plant and transmission and distribution wires and these, as well as the customers they serve, are geographically fixed. Full market liberalisation, especially at the retail level, has yet to be implemented for various technical reasons.

[31]It should be clear to the reader that the transaction cost of establishing the contractual relationship is distinct from the transaction cost of enforcing it. The costs in the former case are the direct costs associated with the privatisation exercise and these costs in and of themselves may be significant since they require "detailed analyses, tough negotiation, complex legal contracts, expensive monitoring arrangements, and possibly the high costs of settling disputes in court," (Irwin, et. al 1999). In the UK privatisation case, Newbery & Pollett (1997) estimated such restructuring costs to total as much as 2% of the total pool price.

renege on their commitments. While rules and contracts will protect the investor to some extent, past experience has left it clear that private investors have little recourse when governments have determined to expropriate their earnings. This does not, however, mean that it will be impossible to attract investors in situations where policy credibility is found wanting. It only means that in such situations policy risks are higher and, consequently, the discount rates demanded by private investors to compensate for these risks will be higher.

Investors themselves have been incorporating the effects of policy and regulatory risks as they have prepared their bids for privatisation. During infrastructure privatisation investors have generally made their bids based on future utility rates, either pre-defined by the government or estimated by the investor. Knowing what the rates will be allows the investor to appropriately discount the present value of the assets. The process may also be reversed. In the Buenos Aires water privatisation case, for example, the government gave away the water company without charge. Investors were required to bid on the lowest water tariffs they would charge to provide a defined set of services and to meet a defined series of investment targets. By appropriately discounting their capital costs—implicitly accounting for policy and regulatory risks—the winning investor was able to bid an appropriate tariff. The point is that in privatisation processes asset prices are flexible in the sense that investors pay for the asset based on estimated revenues and, therefore, privatisation is capable of attracting investors under a wide range of revenue expectations. If the investors perceive the risks to be high, this will be reflected in lower bids and lower privatisation prices. In the case of new investments, however, the costs of assets are more or less fixed and it is the revenue stream that has to prove adequate if investors are to be attracted. In other words, utility rates have to reflect the impacts that policy and regulatory risks have on the costs of capital. This helps explain why private power investors in Brazil are reluctant to invest in additional plant capacity despite their previous enthusiasm for privatisation.

To complete our understanding of policy and regulatory risks we would need to ask what measures exacerbate and what measures ameliorate them. At a minimum, asset specificity in the presence of incomplete contracts is what allows the exercise of opportunism (which can be defined as self-interest combined with a willingness to bend and break the rules of the game).

The exercise of opportunism depends how much it costs the government. Governments' costs of policy opportunism are inversely related to how acceptable it is for the government to renege on its commitments. For example, if a country suffers a significant and negative macroeconomic event it will be politically more beneficial to argue that infrastructure investors—especially foreign infrastructure investors—share in the economic pains of the population. In such a case, even if the private investor is contractually protected, the policy risk that her revenues will be reduced will be elevated. This risk will be even more elevated if rates are denominated in hard currency and the local currency devalues sharply. With nominal rates increasing even as economic difficulties assail the consumers/citizens, policy risks for the investor will increase. On the other hand, if the government is really concerned about attracting further investment, policy risk in the medium term might remain low even in the presence of other pressures. What this illustrates is that policy risk is not constant through the life of an infrastructure project but that it changes based on economic and political conditions. It is important to note in such circumstances is that these effects often set off a mutually reinforcing chain of events: economic stress may trigger contractual clauses (such as rates indexed to inflation or the exchange rate) that cause prices to rise; rising prices add to policy risks by making government opportunism more legitimate politically; the increase in policy risk causes

costs of capital to increase putting further upwards pressure on prices while simultaneously higher costs of capital may reduce investment creating supply shortages and pushing up prices even more; rising prices induce a government reaction thus increasing policy risk, and so on.

The policy risks of investment related to privatisation are themselves context-specific. For example, the policy and regulatory risks for investors in the bicycle industry are obviously less than they are in the electric power industry. For one, asset specificity in this industry is low so even if the government were to consider it one of its public responsibilities to provide bicycles for its citizenry, it can do so on a competitive basis. For another, the industry does not have significant backwards or forwards linkages, so the legitimacy of government involvement in it is low. The question of the steel used in bicycle manufacturing is an entirely different one from which it would be easy to draw the opposite conclusions and, in fact, policymakers have repeatedly done so. The important point is not whether the market for the product is competitive or can be made competitive, but rather what is the degree of asset specificity and what is the degree of government interest and ability—or, in other words, the political legitimacy—in having the outputs of the industry serve particular policy and political objectives. Hence, because policy and regulatory risks are lower, public capital does not have as much of a cost advantage over private capital in the bicycle industry as it does in the electric power industry.

Similarly, policy and regulatory risks are lower in industrialised countries than in developing countries and also vary across developing countries. Institutional attributes such as the strength and independence of the judiciary account for some of this diversity but the legitimacy of government intervention also explains a lot about how risky the policy and regulatory environments can be. Critical differences between developed and developing countries in infrastructure markets include their high cost relative to income, the high participation of foreign capital and the high levels of return that it demands, all of which help foster an us-versus-them mentality. As a result, the relative advantage of public over private capital in industrialised countries is lower than in developing countries. This exactly parallels the findings in the transactions cost literature, which claims that transactions costs in developing countries are higher than in industrialised countries.

The value of this approach to evaluating the impacts of privatisation on the cost of capital is that it provides us with a better understanding of the financial dynamics that underpin privatisation and points us in the right directions for more robust policymaking with regards to privatisation. By adopting this framework, we see clearly why outside of the theoretical realm public capital cannot be evaluated at the same rate as private capital. Adopting this approach does not in itself fundamentally alter the dynamics of the situation but it does clearly indicate that policy and regulatory risks are real costs imposed upon the private investor which can be avoided through public provision. In other words, the public cost of capital is cheaper than the private cost of capital by an amount equal to the policy and regulatory risk.

This framework also allows the incorporation the negative effects of public ownership on efficiency. Indeed, one of the fundamental trade-offs in the make or buy decision is between internal production efficiencies and the transaction costs involved with contracting for the good or service. Consequently, this framework allows policymakers and analysts to calculate more accurately the potential impacts of privatisation on prices and investment. By determining approximately the magnitudes of policy and investment risks on the costs of capital and the share of capital in total operational costs and by adjusting for expected gains in productive efficiency

one can estimate whether prices will rise or fall and by how much. By formally incorporating policy and regulatory risk in such calculations one should also be able to force a more honest evaluation of these risks rather than merely elicit vague and unenforceable promises from the government to eliminate them.

The analysis presented here has been positive, not normative. The paper offers no opinion on the intrinsic desirability of privatisation, only an argument to recognise accurately the risks involved with the privatisation process. The decision-making implications are clear: sectorial reforms involving privatisation have an inherent risk based on the potential trade-offs between productive efficiency and the transactions costs of dealing with and accounting for policy and regulatory risks and these ought to be explicitly evaluated.

If privatisation is essentially a make or buy decision then the following factors need to be evaluated: the relative inefficiency of the public with respect to the private sector in the production of the good or service under consideration and the policy and regulatory risks involved with privatisation.

This discussion provides a basis for introducing the concept of the "riskiness" of reforms (see Figure 1). If the policy and regulatory risks are low but there is little difference in efficiencies between the public and the private sector, then there is little to be gained or lost through privatisation, which is the situation we encounter in many industrialised country privatisation experiences. Reform under these circumstances has a low risk. The gains in efficiency are unlikely to be great, but the policy and regulatory risks are also low. With little difference between public and private costs of capital and between public and private sector efficiency, privatisation is unlikely to result in substantial changes in prices and service quality. The privatisation of Great Britain's electric power industry illustrates this well. Many analysts have shown that large efficiency gains were not realised through the British electric power privatisation exercise because the industry was already quite efficient under state ownership. Newbery & Pollett's (1997) analysis shows that there were some absolute gains accruing from privatisation—on the order of 2% of final prices. They did not take into consideration any possible differences in the costs of capital between the British public and private sector, but these differences were, in any case, small.

If policy and regulatory risks are high but at the same time there is a big difference in private and public sector efficiencies then it might well be worth privatising. The Argentine electric power privatisation case is fairly representative in this case. Like any developing country embarking upon a massive economic overhaul, policy risks in Argentina were high. At the same time, the Argentine power sector was highly inefficient, plagued by power losses, overstaffing and poor operational performance. The policy and regulatory risks were substantial but so were the potential benefits. The risk of the reform adjusted with the potential benefits was, therefore, medium.

If the relative differences in efficiency in the public and private sectors are low but the policy and regulatory risks are high, then privatisation will deteriorate the social welfare function. The risks of reform in this case are high. Policy and regulatory risk are likely to increase substantially the costs of capital that are applied, but the corresponding efficiency gains will be unlikely to compensate for these increased costs. As I will show in the following section, Brazilian electric power privatisation is representative of this case.

6. The Impacts of Power Reforms on Risk and Prices

It is axiomatic that prices in privatised infrastructure markets will reflect the rates of return required by private investors, which in turn reflects the risks assumed in the investment. Clearly then, an increase in risk creates upwards pressures on prices although these pressures can be reduced or even completely overcome if efficiency gains are sufficiently high.

What was the impact in the Brazilian electric power industry? The empirical evidence presented in Section IV suggests that costs of capital increased by at least 4.8% (1.5% due to additional policy risk and 3.3% due to additional regulatory risk at the lower bounds of estimation) and could have increased as much as 10%, even if we ignore the public sector's ability to obtain debt at a lower rate. On the efficiency side, by 2000, generation efficiencies increased by about 10% in the best privatised case and by about 5% in the best state-owned case.

Were the efficiency gains sufficient to overcome the increase in the costs of capital? The potential impacts of increases in the costs of capital on wholesale power prices can be estimated using data on the capital and operational costs of hydro and thermal power plants (see summary in Tables 3 and 4). The data indicate that hydropower plants constructed with project finance consisting of 40% equity and 60% debt would produce electricity for US$ 36.62/MWh, given a required return on equity of 18% and cost of debt at 8% (i.e., a WACC of 11%—ignoring, for the moment, the taxation differences between equity and debt). Debt costs are set at 8% because the BNDES currently offers loans for electric power investment at that rate. Running the same calculations with a return on equity of 15% reduced power prices by $4.75/MWh. In other words, for each percentage difference in average capital costs, wholesale power prices would change by 15%. For thermal power, the price sensitivity to cost of capital increases was much lower. A percentage change in average capital costs caused a 4.73% change in total costs.[32] Thermal power plants, however, suffered from a higher market risk. It was not only more expensive—around US$ 38 per MWh for thermal vs. US$ 32 per MWh for hydro—but also exposed the investors to exchange rate risk since most of the natural gas to be used in these plants had to be imported from Bolivia and Argentina and paid for in dollars at international rates.

In terms of efficiency, while the privatised generation company did achieve greater operational efficiencies than the federally-owned generation companies, the gains did not offset the effect of the increase on the nominal cost of capital. Comparing efficiency gains with the cost of capital increases described in the previous sections clearly indicates that on the balance there was substantial pressure to increase prices. If a 1% increase in the cost of capital translates into a 15% increase in costs for over 80% of the installed capacity, then efficiencies in the Brazilian electric power industry would have to practically double after privatisation to compensate for a 5% to 6% increase in the nominal cost of capital.

On the generation side, because of the structure and the technology of the industry, such large increases in operational efficiency are not possible in Brazil. Power generation in Brazil is

[32]In the case of thermal power investments, equity was estimated at 30% of total capital because the government intended to provide additional lines of credit to incentivise thermal power production based on natural gas.

overwhelmingly hydroelectric. One of the defining characteristics of hydropower is that its operational costs are very low—consisting mainly of routine maintenance and opening and closing sluice gates—and its capital costs are very high. In Brazil, capital costs of hydropower account for over 80% of total costs whereas capital costs for natural gas fired thermal plants account for only about 30% of total costs (see Tables 3 and 4). Analysing the spot-market prices for hydropower in Brazil clearly reveals this fact (see Chart 5). When the hydropower reservoirs are full and the opportunity cost for storing the power low, firms have been noted to sell power at essentially the operational costs, which have been about US $5 per MWh. Even if operational costs are greatly reduced through efficiency gains, they form such a small portion of total costs that their impacts on sector prices would not be significant. Privatising hydropower, therefore, would in a relative sense yield little efficiency. Similarly, deregulation and liberalisation would also be unable to induce large increases in efficiencies in the Brazilian electric power generation sector.

A similar result holds even for investment in new infrastructure. The government may be less efficient in constructing new infrastructure, but if its capital costs are much lower and capital costs are a significant component of final costs then even though the state-owned firm is less efficiency productively, it would be able to offer lower prices.

The fundamental conclusion of this empirical research is that policy risk in power generation privatisation was high and potential efficiency gains low. The Brazilian electric power reforms were conducted during an economic stabilisation programme whose principal focus was to control inflation but the reforms were quite likely to put significant upwards pressure on prices. Given that electric power is a basic input in almost all industrial and commercial processes, it would be likely that sustained increases in electric power prices would drive up inflation. In such an eventuality, the government would be forced to step in and rescue the stabilisation programme, very likely leading to some sorts of control on electric power prices. This would, in effect, set off a negative feedback loop on policy and regulatory risks. Attempts to control prices would be seen by investors as manifestations of policy and regulatory risk, further increasing their perceptions of such risks. This would translate into demands for higher discount rates and curtailments in investment programmes. Curtailed investment could lead to mutually reinforcing tighter energy supply markets, an increase in prices, a stronger policy response and higher policy risks.

7. Conclusions

Brazilian electric power privatisation fundamentally shifted the nature, amount, incidence and compensation of investment risks in the sector. Privatisation forced investors to consider the various policy risks and changing the regulatory system for the monopolistic parts of the industry introduced regulatory risks. Under government ownership these risks were usually ignored when calculating discount rates but privatisation forced an explicit recognition of these risks. The cost of debt and equity of the private sector thus substantially exceeded that of its public counterparts in the Brazilian electric power industry.

On the issue of efficiency impacts of privatisation, reformers have argued that private owners could be compensated for the increased risks that they bear while at the same time the pressures to increase prices could be mitigated. Almost a decade ago, as the privatisation

movement was gaining strength through much of the developed and developing world, the World Bank's *1994 World Development Report*, which was devoted to infrastructure, invoked this issue, stating that, "in infrastructure projects, the cheaper credit available to governments needs to be weighed against possible inefficiencies in channelling funds through government."

In practical terms, given public capital's advantage in the electric power industry, it is not enough for organisations to become merely more efficient than they were previous to privatisation; they must boost efficiency to a degree sufficient to recuperate the increased costs of capital. On this issue, the paper has argued that in the case of Brazilian electric power reforms, the condition regarding the trade-off between cost of capital and efficiency was, in fact, not satisfied. Privatisation did increase levels of efficiency in the Brazilian electric power industry. However, the Brazilian power firms were, on average, not sufficiently inefficient under state ownership and the structure of the industry with its hydro dominance did not allow the private sector to make the kinds of efficiency gains that would have compensated for the increased rate of return requirements. Thus, one lesson from Brazil's electric power reform experience is that if new investment requirements are substantial, then infrastructure privatisation should be the preferred strategy only for those countries with highly inefficient government enterprises.

From relevant policy perspectives, the relative magnitude of capital versus operational costs in a project or industry thus assumes particular importance. The larger the relative capital outlay in an industry, the more sensitive it will be to changes in required rates of return resulting from privatisation and liberalisation and the less likely it is to benefit from increases in operational efficiencies. In the Brazilian electric power industry, the relatively low operational costs of hydropower plants meant that even large efficiency gains would be overwhelmed by small increases in capital costs.

The results from this analysis are thus counterintuitive. Just because a sector is theoretically competitive does not automatically mean it is ripe for privatisation and liberalisation. The Brazilian electric power reform experience shows that the potentially competitive generation sector was actually a poorer candidate for privatisation because of its relatively higher capital to operating cost ratio and the higher associated policy risk. Privatisation of Brazilian distribution companies was, in fact, a more robust decision than attempting to privatise generation given the fact that capital costs of distribution are relatively lower than operational costs when compared to generation.

This paper does not argue a general theoretical case against privatisation but it does caution against orthodox reform in an infrastructure industry where the policy risks are high and the potential efficiency gains are low. As such, what the paper has argued most strongly for is appropriate contextualisation in deciding when how and where to reform. Just as one cannot make a universally-applicable judgement about the make or buy decision in the private sector, one cannot pass similar judgement about privatisation. If the existing state-owned firms are not substantially inefficient, privatisation might yield little benefit to consumers. If government operation is very inefficient then regardless of what the theory says about public and private finance, the social function can be improved through privatisation. In Argentina, for example, the existing state-owned power firms were so inefficient that privatisation, even with increased rates of return demanded by the investors, yielded net benefits to the consumers. On the other hand, if the root causes of inefficiency are government policy and not government ownership then the

introduction of more market-oriented policies, or commercialisation, may well be a policy superior to that of privatisation.

Incorporating the effects of changes in risks and the costs of capital into privatisation and liberalisation analyses thus enriches our understanding of the dynamics of reform because it helps explain when, where and why reform efforts might fail on economic and political grounds. For example, on economic grounds, if reforms introduce more risk and uncertainty for the investor—risks that the investors are not able to compensate for by increasing operational efficiencies—then on the balance prices will rise and the reforms might prove to be unsustainable. If capital costs are a substantially larger proportion of total life-cycle costs than operational costs, then increased operational efficiencies may not be reason enough to privatise and/or liberalise because then the effects of more expensive capital might dominate over increases in operational efficiencies. On political grounds, if reforms do not bring visible improvements and benefits to the consumer despite the increase in prices then they might well be difficult to defend politically even if they are entirely justified on the grounds of economic theory. This strongly suggests that privatisation studies should do much more to analyse both the balance of risk introduced into the system through reforms efforts and the relative costs of capital for the public and private sector.

REFERENCES

Alchian, A. 1965. "Some Economics of Property Rights," Il Politico 30.

Alchian, A. and H. Demsetz. 1972. "Production Information Cost and Economic Organization," *American Economic Review.*

ANEEL. 2003. Nota Tecnica No. 030/3003-SRE/ANEEL. Brasilia.

ANEEL. 2001. Nota Tecnica No. 97/2001/SRE/ANEEL. Brasilia.

Arrow, K. 1965. *Aspects of the Theory of Risk-Bearing*. Yrjö Jahnssonin Säätiö: Helsinki.

Arrow, K. and R. Lind. 1970. "Uncertainty and the Evaluation of Public Investment Decisions," *American Economic Review.*

Braeutigam, R., and J. Panzar, 1993. "Effects of the change from rate-of-return to price-cap regulation," *American Economic Review* 83 (2).

Branston, J. 2000. "A Counterfactual Price Analysis of British Electricity Privatisation," *Utilities Policy.* 9.

Buchanan, J.M. & G. Tullock. 1962. *The Calculus of Consent: Logical Foundations Of Constitutional Democracy*. Ann Arbor: University of Michigan Press.

Clark, T. & C. Pitelis, 1993. The Political Economy of Privatisation. London: Routledge.

Coase, R. 1937. The Nature of the Firm. Economica, 4.

Culy, J., Read, E.G & Wright, B. 1996. "Structure and Regulation of the New Zealand Electricity Sector" in R Gilbert and E Kahn (eds), International Comparison of Electricity Regulation. Cambridge: Cambridge University Press.

Demetz, H. 1967. "Toward a Theory of Property Rights," *American Economic Review Papers.*

Diamond, P. and J. Stiglitz. 1974. "Increases in Risk and in Risk Aversion," *Journal of Economic Theory.*

Faere, R., S. Grosskopt, J. Logan. 1985. "The relative Performance of Publicly Owned and Privately Owned Electric Utilities," *Journal of Public Economics* 26.

Gerschenkron, Alexander. 1962. *Economic Backwardness in Historical Perspective.* Cambridge: Harvard University Press.

Gómez-Ibañez, J.A. 2003. *Regulating Infrastructure: Monopoly, Contracts, and Discretion.* Cambridge: Harvard University Press.

Grout, P. 1997. "The Economics of the Private Finance Initiative," *Oxford Review of Economic Policy* 13 (4).

Haendel, D. 1979. *Foreign Investment and the Management of Political Risk.* Westview Press: Boulder.

Hart, A. 1942. "Risk, Uncertainty and the Unprofitability of Compounding Probabilities" in Lange et al., editors, *Mathematical Economics and Econometrics.*

Hicks, J. 1931. "Theory of Uncertainty and Profit," *Economica.*

Hirshleifer, J. 1964. "Efficient Allocation of Capital in an Uncertain World," *American Economic Review.*

International Energy Agency. 1999. *Electricity Reform: Power Generation Costs and Investment.* IEA: Paris.

Irwin, T., M. Klein, G. E. Perry, & M. Thobani. 1999. Managing Government Exposure to Private Infrastructure Risks. *The World Bank Research Observer*, 14 (2).

Kakecki, M. 1937. "The Principle of Increasing Risk," *Economica.*

Kay, J.A. and Thompson D.J. 1986. "Privatisation: A Policy in Search of a Rationale," *The Economic Journal* 96.

Keynes, J. 1936. *General Theory of Employment, Interest and Money.* Harcourt, Brace: New York.

Klein, M. 1997. "The Risk Premium of Evaluating Public Projects," *Oxford Review of Economic* Policy 13 (4).

Knight, F. 1921. *Risk, Uncertainty and Profit.* Harper & Row: New York (1965 ed).

Makower, H and J. Marschak. 1938. "Assets, Prices and Monetary Theory," *Economica.*

Markowitz, H. 1952. "Portfolio Selection," *Journal of Finance*

Masten, S., J. Meehan & E. Snyder. 1989. Vertical Integration in the U.S. Auto Industry: A Note on the Influence on Transaction Specific Assets. *Journal of Economic Behaviour and Organisation,* 12.

Megginson, W. & J. Netter, 2001. "From State to Market: A Study of the Empirical Studies on Privatisation," *Journal of Economic Literature,* 39.

Monteverde, K. & D. Teece. 1982. Appropriable Rents and Quasi-Vertical Integration. *Journal of Law and Economics*, 25.

Newbury. D. & M. Pollett 1997. The Restructuring and Privatisation of CEGB—Was it Worth it? *Journal of Industrial Economics* 45 (3).

Niskanen, W. 1977. *Budgets and Bureaucrats: The Sources of Government Growth.* Durham, N.C.: Duke University Press

North, D. 1990. *Institutions, Insitutional Change and Economic Performance.* Cambridge: Cambridge University Press.

Ramsey F. 1926. *Truth and Probability.*

Rothschild. M. and J. Stiglitz. 1970. "Increasing Risk I: A Definition," *Journal of Economic Theory.*

Rothschild. M. and J. Stiglitz. 1971. "Increasing Risk II: Its Economic Consequences," *Journal of Economic Theory.*

Sappington, D. 1980. "Strategic Firm Behaviour Under a Dynamic Regulatory Adjustment Process," *The Bell Journal of Economics* 11.

Savage, L. and M. Feiedman. 1948. "The Utility Analysis of Choices Involving Risk," *Journal of Political Economy.*

Savage, L. 1954. *The Foundations of Statistics.* Wiley: New York.

Sherman, R. 1989. *The Regulation of Monopoly.* Cambridge University Press: New York.

Smith. 2003. Insert cite.

Stigler, G. 1939. "Production and Distribution in the Short Run," *Journal of Political Economy.*

----------. 1971. "The Theory of Economic Regulation," *The Bell Journal of Economics and Management Science* 2.

Tendencias Consultoria Integrada. 2003. *Parecer Economico Sobre Revisao Tarifaria e a Estrutura e os Custos de Capital das Distribuidoras de Energia Eletrica no Brasil.* Sao Paulo.

Tendler, J. 1968. *Electric Power in Brazil; Entrepreneurship in the Public Sector.* Cambridge, MA: Harvard University Press.

Tintner, G. 1941. "The Theory of Choice under Subjective Risk and Uncertainty," *Econometrica.*

UK Treasury. 1997. *Private Finance Panel: Further Contractual Issue.* London.

Vernon, R. 1971. *Sovereignty at Bay: The Multinational Spread of US Enterprises.* Basic Books: New York.

Von Neumann, J and O. Morgenstern. 1944. *Theory of Games and Economic Behavior.* Princeton University Press. Princeton.

Vickers, J., and G. Yarrow. 1991. "Economic Perspectives on Privatisation," *Journal of Economic Perspectives* 5(2): 111-132.

Vickrey, W. 1964. "Principles of Efficiency: Discussion," *American Economic Review.*

Villalonga, B. 2000. "Privatisation and Efficiency: Differentiating Ownership Effects from Political, Organisational and Dynamic Effects," *Journal of Economic Behaviour & Organisation.*

Wells, L.T. & E.S. Gleason, 1995. "Is Foreign Infrastructure Investment Still Risky?" *Harvard Business Review.* Sept-Oct.

Williamson, O. 1979. Transaction-Cost Economics: The Governance of Contractual Relations. *Journal of Law and Economics*, 22 (2).

Wortzel, H. & L.H. Wortzel. 1989. "Privatisation: Not the Only Answer," *World Development* 17 (5).

Yarrow, G. 1986. "Privatisation in Theory and Practise," *Journal of Economics and Politics.*

Chart 1: Investments in Brazilian Electric Power 1980-1997

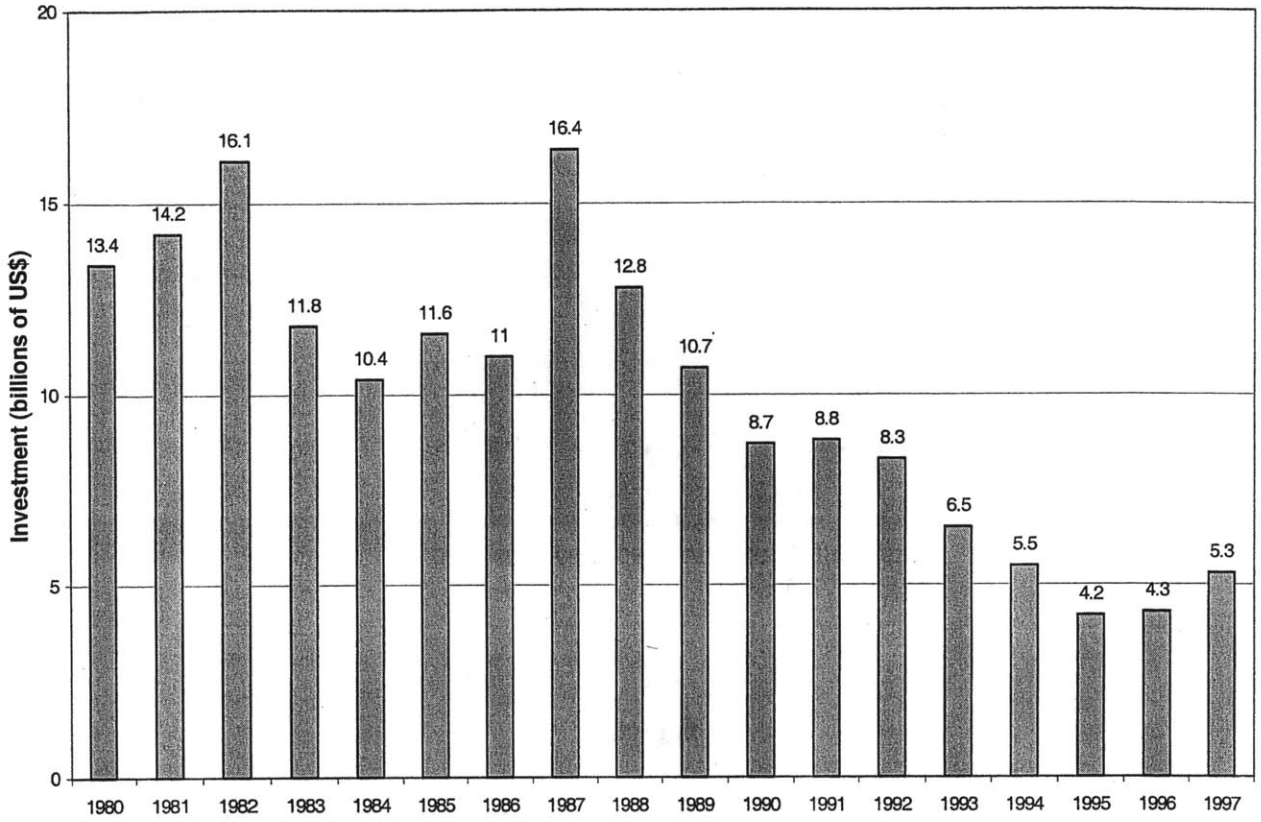


Chart 2.

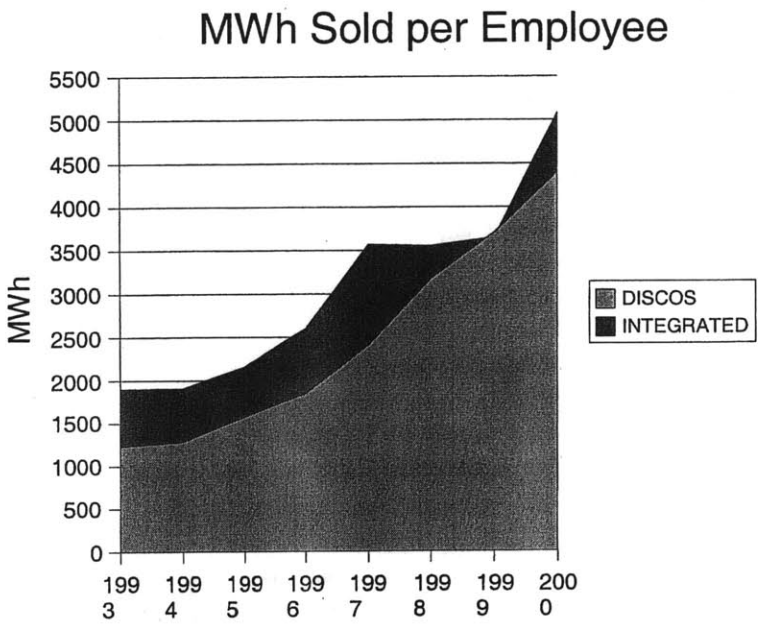


Chart 3.

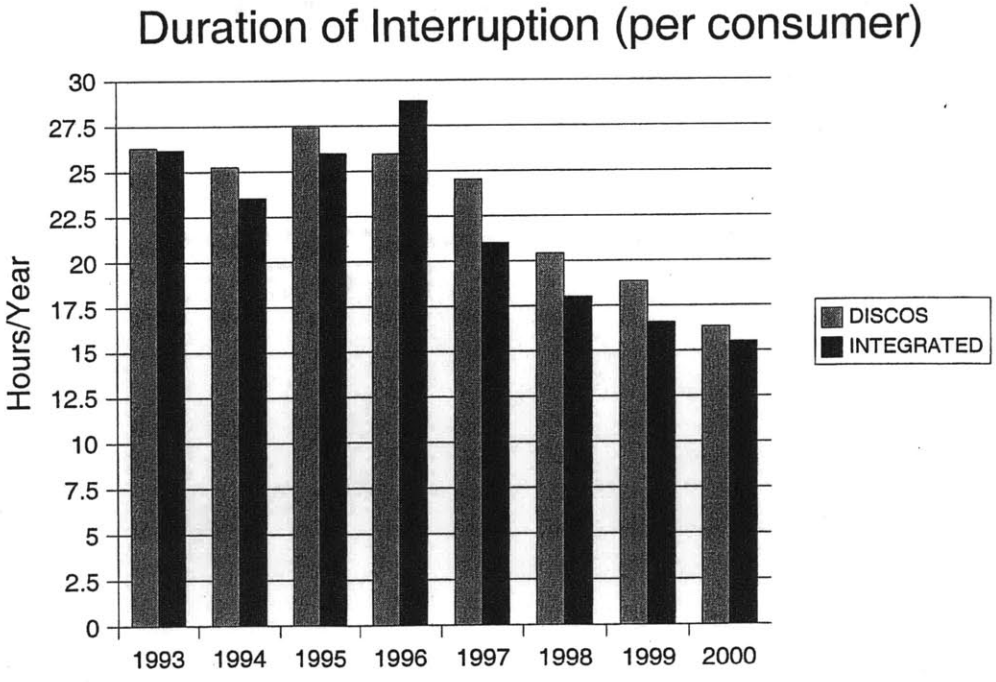


Chart 4.

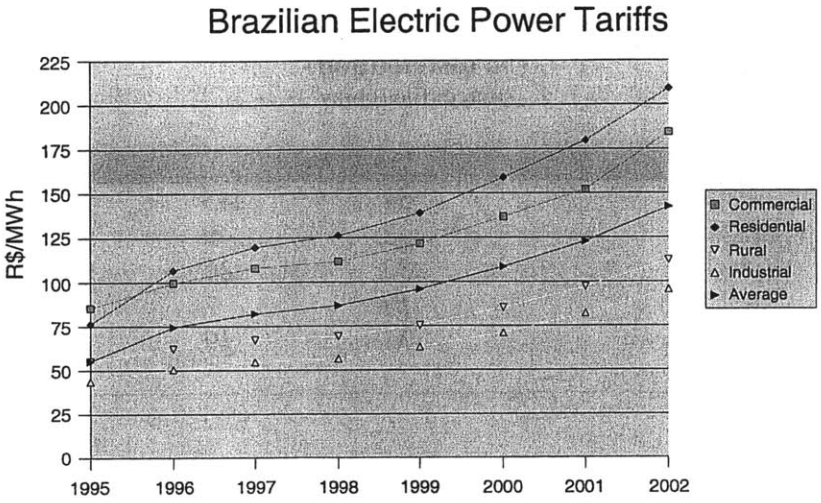
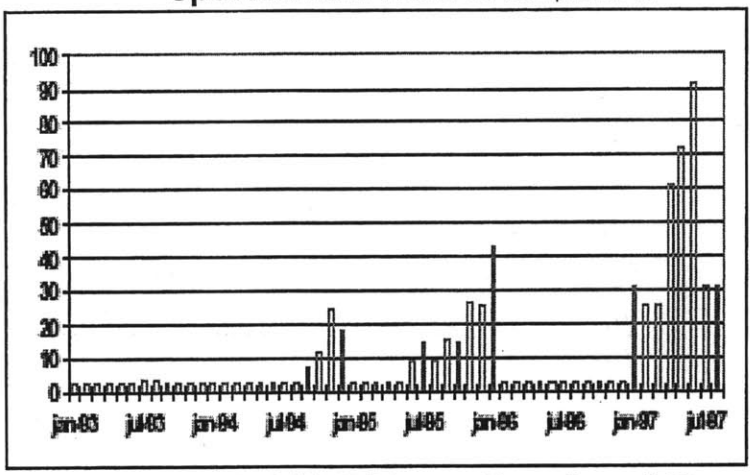


Chart 5.
Spot Market Prices in US$/MWh



Marginal Operational Cost (US$/MWh) as a Function of Storage in Reservoirs

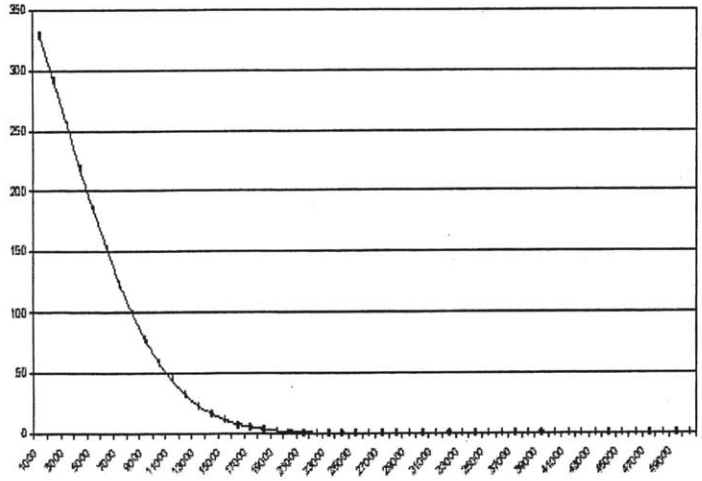


Table 1
Origin of Investment
(% distribution)
source: Eletrobras

	1967	*1973*	*1979*	*1984*
Internal	*34*	*45*	*24*	*18*
Forced Loans	*8*	*9*	*8*	*4*
State Resources	*32*	*20*	*6*	*6*
Domestic Loans	*13*	*7*	*30*	*9*
Foreign Financing	*13*	*19*	*32*	*63*

Table 2
Average Real Electricity Tariffs (1964 = 100)
Source: Eletrobras

Year	*Real Tariffs*
1964	*100*
1969	*150*
1974	*145*
1979	*106*
1984	*98*
1985	*93*
1986	*97*
1987	*102*
1988	*101*
1989	*71*
1990	*73*
1991	*72*

Table 3.
Thermal Power Plant Costs

Parameters			
	Return on Equity	*15.00%*	*18.00%*
	Equity	*30.00%*	*30.00%*
	Debt	*70.00%*	*70.00%*
	Cost of Debt	*8.00%*	*8.00%*
	Capital Outlay per kW installed	*$600.00*	*$600.00*
Costs (US$/MWh)			
	Capital Costs	*9.86*	*10.94*
	Fuel	*20.15*	*20.15*
	Other O & M	*5.22*	*5.22*
	Misc. Taxes	*2.71*	*3.32*
TOTAL		*37.84*	*39.63*

Table 4.
Hydropower Plant Costs

Parameters			
	Return on Equity	*15.00%*	*18.00%*
	Equity	*40.00%*	*40.00%*
	Debt	*60.00%*	*60.00%*
	Cost of Debt	*8.00%*	*8.00%*
	Capital Outlay per kW installed	*$700.00*	*$700.00*
Costs (US$/MWh)			
	Capital Costs	*21.09*	*24.33*
	Fuel (Water Charge)	*1*	*1*
	Other O & M	*4.39*	*4.39*
	Misc. Taxes	*5.39*	*5.39*
TOTAL		*31.87*	*36.62*

Table 5 .
Debt-Total Capital Ratios of Brazilian Distribution Companies
(State-Owned firms in Bold)

FRIM	1997	1998	1999	2000	2001	3rd Q 2002	Average (firm)	Weight
AES Sul	40.5	67.4	87.5	95.1	84.3	120.6	75.0	3.3
Bandeirante			69.1	77.2	76.1	78.0	74.1	2.2
Cataguases-Leopoldina	44.0	47.4	53.6	59.7	59.5	59.2	51.0	0.9
CEB	**30.3**	**28.5**	**28.9**	**35.1**	**55.1**	**69.4**	**35.6**	**1.2**
CEEE	**66.7**	**72.2**	**78.3**	**78.6**	**80.3**	**85.3**	**75.2**	**3.3**
CELESC	**27.5**	**42.4**	**51.6**	**54.9**	**63.5**	**64.2**	**48.0**	**2.8**
CELG	92.6	97.9	72.7	80.4	92.0	114.8	87.1	2.2
CELPA	57.5	49.2	54.7	58.3	53.6	59.7	54.7	2.1
CELPE	29.9	39.9	42.6	51.1	50.0	57.5	42.7	2.6
CEMAT	56.7	59.0	67.0	75.3	66.1	71.9	64.8	1.9
CEMIG	**29.1**	**29.3**	**33.8**	**34.2**	**47.4**	**56.0**	**34.8**	**15.3**
CERJ	74.5	84.7	89.7	86.3	94.7	97.3	86.0	4.4
COELBA	49.2	50.5	57.8	55.5	55.0	57.4	53.6	4.0
COELCE	49.0	53.7	30.0	35.2	48.7	53.3	43.3	2.7
COPEL	**34.6**	**37.0**	**39.9**	**38.4**	**17.9**	**25.6**	**33.6**	**6.9**
CPFL	46.1	49.7	30.0	31.9	51.4	59.9	41.8	9.3
Elektro		53.1	49.7	53.0	79.8	110.5	58.9	3.4
Eletropaulo		69.0	66.5	71.0	74.8	82.3	70.3	14.2
Enersul	52.3	44.2	51.9	51.8	56.3	61.1	51.3	1.3
Escelsa	49.2	51.1	61.4	63.8	71.5	97.2	59.4	2.8
Light	33.5	62.1	72.4	76.0	101.1	85.7	69.0	13.4
Average (year)	**48.0**	**54.4**	**56.6**	**59.7**	**65.7**	**74.6**	**56.9**	**100.0**

Note the lower debt level of state owned firms. CEEE appears with a higher than average debt because the firm was split into three parts, of which two parts were privatised and during this process, all of the debt of the original company was transferred to the remaining state owned company.

Figure 1
The Risk-Efficiency Grid

Paper Three

MISCHIEVOUS MARKETS

An Exploration of the Potential Effects of Deregulation on Investment in Brazil's Electricity Industry

1. Introduction

In the aftermath of Brazil's electricity rationing in 2001, Francisco Gomide, a career electricity man, was called in to take charge as the Minister of Mines and Energy and guide the restructuring of Brazilian electric power sector. In his presentations, Gomide had a stock phrase he would often use to describe his government's electricity policy: "as much market as possible; as little government as necessary." The phrase hid more than it revealed. Its main objective was to communicate the government's continuing commitment to private investment and market-based reforms in the electricity industry; a commitment that had taken a severe battering as a result of the rationing. With many, experts and otherwise, blaming the rationing on the power reforms (or lack thereof), it remained not at all clear how much market is in fact possible and how much government is necessary.

It would be easy to blame Brazil's power reforms fiasco on a flawed policy implementation, and many have done so (see, for example, Gall 2000 and Greiner 2002). Such an explanation would, however, be incomplete and unsatisfactory. Brazil's power reform fiasco was not an isolated failure. Internationally, many power reforms have run into serious trouble, even in advanced industrial countries that enjoyed access to ample financial resources, technical expertise and political environments favourable to implementing power sector reforms. Power supply problems have hit various countries—such as Norway, New Zealand, Chile, the United States in California and, of course, Brazil—that have deregulated their electricity markets. This international experience indicates that one of the critical areas in which electricity markets have experienced a lot of trouble has been in generating investment sufficient to maintain reliable supplies, especially in peaking power plants.

This paper investigates why investment has been a troublesome issue in competitive electricity markets and translates the general case to the Brazilian context. It does not present its conclusions based on solely on an analysis of the actual performance of the Brazilian electricity markets. The main reason for this is that the Brazilian power reforms were never fully operationalised. Rationing hit Brazil as the power markets were still in a transitional phase and the planned liberalisation was only partly implemented. Even though the Brazilian electricity market was only partially liberalised, we can still analyse, using technical documents and other information about the industry, what some of the potential impacts of liberalisation might have been. Indeed, the Brazilian electricity market liberalisation remained incomplete partly because the problems related to market-making. What the paper does intend to do is explain, by reviewing international experience and analysing the Brazilian case in terms of actual and potential dynamics, why it proved to be so difficult to design a well-functioning power market in Brazil in the first place. It is based on an analysis of dozens of technical documents prepared by various government agencies in Brazil, interviews with sector professionals and academic literature on electric power market liberalisation in other countries.

In analysing the problems with Brazil's electricity reforms, this paper puts forward a series of propositions that can aid in understanding the conditions under which electricity reforms become inherently more difficult, especially from the point of view of generating new investments. Two useful propositions to introduce at this stage are that electricity markets have found it difficult to create the right incentives for investment (i) when the marginal cost of new power plants are more than the marginal costs of the existing power plants, and (ii) when the investment required in peaking capacity represents a large proportion of the total investment requirements. In both cases, investors face uncertain returns in competitive electricity markets. Furthermore, such markets have a tendency towards price volatility, which induces a policy reaction that tends to reduce the scope of liberalisation in the industry.

Starting with these issues, the paper traces the difficulties with electricity markets to a trade-off that has to be made between the security of supply and price. Electricity industry reformers have been faced with a choice of increasing the security of supply by allowing higher returns to investors and thereby dampening the effects of competitive markets or increasing price competition amongst suppliers to lower electricity rates at the risk of less reliable supply. When reforms were undertaken in industrialised countries, supply has generally been more or less secure and policymakers have preoccupied themselves with trying to reduce the price of electricity in wholesale markets. The governance structures the policymakers have instituted therefore have focused more on reducing prices, but this was subsequently noted to reduce supply reliability and in some cases cause severe shortages. On the other hand, governance structures geared more towards ensuring secure supplies have been criticised as being too expensive. This fundamental trade-off is of even more concern in developing countries that are trying simultaneously to keep prices low, encourage massive amounts of investment, and maintain reliable supplies. In the electricity market design process, it is not easy to determine and decide which the right governance structures are. Trying to optimise on many fronts simultaneously, policymakers have risked leaving regulatory lacunae and sending out incorrect signals, responding to which markets have played mischief.

The rest of the paper develops these ideas and is divided into six sections. In section II, the paper discusses the trajectory of some countries towards electricity markets; in section III, it relates the international experience with power markets; in section IV, the paper explains the technical and economic reasons behind the difficulty in creating efficient electricity markets; in section V, the paper introduces the reader to the Brazilian electric power system; in section VI the paper analyses the particular difficulties of the Brazilian power reforms; section VII concludes.

2. The Move towards Markets

Industrialised countries have moved only gradually towards competitive electricity markets and while doing so have adopted a variety of approaches. Some have privatised state-owned monopolies, some have divided their electric power firms vertically and horizontally, and some have liberalised only wholesale markets while others have moved more dramatically towards retail level deregulation. Despite the variety of approaches that have been tried, most electricity deregulation exercises were commonly experimental in nature, slow in their transition to liberalised markets and suffered through many mistakes. At the same time, markets have been successful in reducing wholesale rates in many instances by promoting productive efficiency,

reducing labour and maintenance costs and better fuel management strategies (Newbery & Pollitt 1997).

Indeed, in industrialised countries, it was a desire to get cheaper rates that motivated policymakers to deregulate the electricity industry. For many decades, electric power utility regulation had been a comfortable activity. Technical advances and the realisation of economies of scale that caused a steady decline in unit cost had allowed regulators to periodically reduce electricity rates even as utility investors made higher profits and enjoyed good returns on their investments. Where electric power utilities were owned by the state, ample resources were made available to fund capacity expansion. This easy period ended in the early 1970s with the exhaustion of scale economies and the petroleum price hikes. At the same time, new environmental concerns began to pressure utilities and their regulators. With their production costs beginning to rise rapidly, investors clamoured for more frequent rate reviews as regulatory lag, which hitherto had functioned in their favour, now began to eat into their returns. Consumers, on the other hand, began to resent the frequent electricity rate hikes.

Competitive electricity markets often did not come about by design but rather evolved gradually from a series of isolated private and public decisions. In the United States, competition in electricity markets was originally thought to be technically prohibitive and vertically integrated utilities operating in regionally exclusive franchises were generally the norm. However, these utilities themselves began constructing the infrastructure that would eventually make competition amongst them possible. In response to rising power production costs, especially of the peaking supplies which they needed to maintain reliable service for their customers, the utilities began to progressively develop high-voltage transmission networks and experiment with wholesale markets in which they traded electricity amongst themselves. Taking advantage of regional variations in demand and capacity utilisation, utilities "wheeled" power to one another in order to reduce the total amount of installed capacity that they needed to have to maintain reliable supplies (Stalon 1997). These exchanges initially were limited to the small amounts needed to balance supply and demand and did not constitute a real market nor did they fundamentally change the monopolistic regulated nature of electric utilities. But, as it turned out, the high-voltage transmission infrastructure that was built and the small experiments in energy trading that the utilities engaged in on their own initiative became the foundation for later introducing more widespread competition in wholesale electricity markets.

Various market making experiments were subsequently carried out. In one such initiative, the US Federal Energy Regulatory Commission (FERC) obliged utilities to contract with outside suppliers instead of building generation facilities in-house. The 1978 Public Utility Regulatory Policies Act (PURPA), mostly with environmental goals in mind, required utilities to sign long-term power supply contracts with certain types of independent power producers (IPPs), known as Qualifying Facilities (QFs)[33] instead of constructing additional generation facilities themselves.

This early experiment with making electricity markets was not felicitous. While successful in enabling hundreds of IPPs to establish themselves, PURPA did not reduce electricity rates. It turned out that the power supplied by the QFs was more expensive than the utilities' avoided costs and at the same time that the Act forced utilities to buy from QFs, it prohibited them from contracting with non-QFs that could have supplied power more cheaply.

[33]These facilities were mainly co-generators and small producers that used renewable fuels.

Furthermore, the avoided costs established by some state regulatory commissions were so high that it provided incentives for the QFs to supply more power than the utilities could sell. Given that it was the state regulatory commissions that had forced utilities into signing these power purchase agreements (PPAs), utilities were allowed to pass through these costs to the consumers in their retail prices.

Although PURPA did not reduce electricity rates, and indeed it even increased them, the Act did succeed in dispelling the myth that the generation sector was per-force a natural monopoly and in doing so set the stage for a subsequent unbundling of electricity services. PURPA also created pressures for introducing more competition in wholesale electricity markets, though not in the manner that the Act's proponents would have anticipated. Many years later, a rate gap began to appear between those states whose regulators had not aggressively pushed the expensive PURPA-inspired plants and those that had, with the latter having to embed the stranded asset costs of the PURPA-contracted plants into their regulated rates (White 1996). Additionally, states that had to deal with fewer stranded asset problems found it easier to deregulate generation markets, thereby lowering their wholesale rates even more.

In 1992, while regulators were under pressure to deregulate the industry (given their role in causing high prices), the US Congress passed the Energy Policy Act. It removed barriers to entry into the generation market by creating "exempt wholesale generators" (EWG) who were authorised to supply wholesale power to utilities and their competitors. The authors of the Act expected EWGs to use modern generation technologies and thereby reduce costs and supply power at prices lower than what the utilities themselves could achieve. In 1996, FERC's open access rules 888 and 889 further liberalised electricity markets by forcing utilities to allow competitors to access their wires in order to transport and deliver energy.

The US experience shows that the process of deregulating electricity markets was experimental and incremental. It was a learning process in which market making initiatives themselves often failed but the experience gained was in itself valuable as a foundation for continuing efforts in the area. And, progressively, electricity markets did become more sophisticated and complete.

Similar trends were ongoing globally and, in fact, the United States did not lead this trend towards making wholesale electricity markets. Much of the progress in the US was in fact an imitation of other countries where bolder reforms were being spurred by simultaneous processes of privatisation. Indeed, the existence of already private utilities to some extent impeded more dramatic restructuring in the United States because of concerns about breaking the regulatory contract and the taking of private property rights.

Of the major electricity reforms, the one implemented in England & Wales has received the most attention and has been widely identified as the inspiration for a series of reforms in other countries. Unlike the mostly private and regionally diffuse electricity industry in the United States, England & Wales were served by state-owned corporations. Like the United States, however, the political climate in 1980s Great Britain favoured reducing the role and scope of the state in the economy. In 1988, the UK Department of Energy commissioned a White Paper for developing a competitive electricity industry based upon which the UK Electricity Act was passed the following year. The Act separated the electricity industry along functional lines—generation, transmission, and distribution—intending to introduce competition into generation markets and incentive-based regulation into the transmission and distribution segments.

Subsequently, the government split up the state-owned Central Electricity Generation Board (CEGB) into a national transmission company and three generation companies.[34] Britain's 12 Regional Electric (distribution) Companies were privatised in December 1990 and the two fossil-fuel power generators in March 1991. The national transmission company was initially owned jointly by the 12 RECs but later was spun off as an independent publicly-traded corporation.

Given that the British electricity reform was more a political programme, it focused on privatisation and market-making and did not initially address the issue of market power. For all practical purposes, the generation sector was left as a duopoly, with one generator (National Power) owning 46% of the total installed capacity and the other (PowerGen) owning 28%. The rest of the power was supplied by the 12 RECs and Nuclear Electric. As a result of this concentration, National Power and PowerGen were frequently accused of exercising market power. In the retail sector, the RECs maintained their exclusive franchises, although customers whose peak demand was greater than 1 MW could purchase their power competitively from the RECs or directly from the generation companies. Later, in 1994, this limit was reduced to 100 kW and in 1998 even residential customers were allowed to choose their suppliers.

The main innovation of the British electricity reform was the creation of a national wholesale electricity market. While the authors of the White Paper themselves had expected the British electricity market to be based on bilateral physical contracts between generators and distributors, it turned out that the spot market or pool became the centrepiece of the system. The power pool was basically a commodities-type market in which all producers were required to submit bids on a half-hourly day-ahead basis. Based on the bids, the national systems operator would dispatch power in a merit order starting with the least expensive plant until all the demand would be satisfied. The pool price, which was received by all generators, was the market clearing price and equal to the bid value of the last (most expensive) generation unit dispatched. The designers of the market expected that, theoretically, the generators should bid at their marginal operating costs and so the pool price should generally reflect the system's overall marginal operating cost. A capacity payment was added to the pool price in order to ensure enough surplus capacity in the system to maintain security of supply.

Electricity had to be compulsorily sold through the pool. Consequently, the price of electricity varied by the half-hour. However, most customers purchased electricity though annual contracts at fixed rates independent of the variations in the pool markets. The contracts were, however, allowed to have predefined variations in prices depending upon when the power is consumed. In order to hedge themselves against adverse variations in pool prices, RECs purchased contracts for differences (CfDs) where if the pool price is more than the strike price then the generators pay the RECs the difference and vice versa.

A different, less political and more technical, approach to electricity reform was undertaken in Norway, which did not consider privatising its state owned electricity companies at all. Instead, while retaining state ownership Norway implemented a highly decentralised free-trade model in which a large number of generation and distribution companies and even small consumers could buy and sell electricity in the pool markets. Selling in the pool was, however, not made compulsory and over 80% of the energy is still traded bilaterally.

---

[34]Initially, the plan was to have two privatised generation companies, one larger than the other in order to absorb the country's nuclear facilities. As it turned out, the nuclear facilities were not privatised initially and instead a surcharge was applied to customers' bills in order to allow nuclear energy to be competitively dispatched. The nuclear power generator was finally privatised in 1996.

Norway began its electricity reforms more or less at the same time as the Britain did, having passed its Energy Act in 1990. Prior to this act, the country's electricity industry was regulated via cost-plus contracts and energy trading was highly restricted. The Energy Act created a power pool market which was opened to all consumers, potentially even residential customers. Because Norway's electricity industry was historically composed of small municipal companies, market power was not an issue. In fact, when it began its reforms Norway had over 300 separate electricity firms although the federal generation and transmission company, Stattkraft, did produce about 30% of the country's electricity. As part of the reforms, Stattkraf's transmission business was separated into a new company, Stattnet. In 1996, Norway and Sweden combined their power markets and formed a new pool company called Nordpool. Subsequently, in 1997, to promote retail competition, Norway eliminated all switching fees and in the following year, permitted customers to switch suppliers on a weekly basis.

Other countries, driven variously by more political or more technocratic forces, were also moving forward with their own efforts at deregulating electricity markets. Chile, in fact, preceded England in electricity reforms having begun experimenting with electricity market deregulation in 1978. By 1982, Chile had privatised the industry while also guaranteeing generators open access to transmission networks and the wholesale power market. In 1992, Argentina followed with an electricity privatisation programme modelled after the Chilean one but went further to promote competition by requiring a complete vertical separation between generation, transmission and distribution functions and limiting the size of generators to less than 10% of the national market. Australia began its electricity reforms in the early 1990s and went for unbundling, corporatisation and privatisation of state-owned firms, introduction of competition in wholesale and retail markets, and a reduction in, with a view to the eventual elimination of, barriers to entry (Outhred 1998). The process took over 10 years to complete and was slow because it was conducted in a federalised environment. The National Electricity Market was begun in 1998 and was finally completed when New South Wales entered in 2001.[35] The New Zealand electricity reforms went even further and completely commodified the power market. The 1992 Energy Companies and Electricity Acts corporatised the state-owned national power generation company (ECNZ) and the regional electricity distribution companies and eliminated retail supply franchises, monopolies, price controls and public service obligations (Barton 1999).[36] The wholesale market was introduced in New Zealand in 1996. Like Nordpool, it was not made compulsory; unlike the Nordpool, the New Zealand wholesale market does trade a lot of the country's energy. New Zealand also split-up ECNZ and maintained a cap on its investments until its share of power production fell below to 45% of the national market. The 1998 Electricity Industry Reform Act further split ECNZ into three new competing generators and also made distribution companies separate their wires and retail businesses and sell one or the other. To promote retail level competition, the 1998 Act established low switching costs and allowed all customers to choose their electricity suppliers.

Throughout the world, the demonstration effect influenced the pace and character of electric power reforms as countries imitated and adapted reforms from each others' experiences. The demonstration effect borrowed from the experiences not only of other countries but also of other industries, notably telecommunications and, in the case of the United States, natural gas.

---

[35] Western Australia and the Northern Territories did not join the NEM because they are very far from the interconnected NEM of eastern and southern Australia.

[36] The Electricity Act of 1992 did, however, include a temporary provision for price controls for residential customers.

As Joskow (1997) stated, "the reforms sweeping other natural monopoly sectors necessarily lead interest groups, regulators and other policymakers to ponder whether these concepts can and should be applied to electricity for private or social gain."

Although there were great differences in the details, the basic reform model followed by most countries was based on unbundling, or the vertical separation of potentially competitive segments of the electricity industry, such as generation, and those that needed to continue as regulated business, such as transmission. Where countries differed was on the degree of market de-concentration in generation sector and the extent to which the retail sector was liberalised. Privatisation was a common though not universal element of the reform efforts. The variation in the national power policies were a reflection of the intrinsic characteristics of the industrial structure of each country and its economic priorities.

3. Industrialised Country Experience with Electricity Markets

Even though more than a decade has passed since the industrialised countries began experimenting with electricity reforms, the results of these diverse experiences with privatisation, liberalisation and market-making in the electricity industry are still generating polemics. Privatisation and liberalisation has spurred productivity improvements in most countries in which it has been tried and has attracted billions of dollars of private capital investment in the sector. As a consequence wholesale and retail rates have both fallen and become better aligned with costs of services for different classes of customers. However, although the initial evaluations of electricity reforms were generally positive, recent analyses are much more nuanced in their conclusions. In countries that deregulated the electricity sector, wholesale prices generally fell initially but subsequent and severe price volatility has become a major concern. More preoccupying, however, has been the fact that many of the industrialised countries that did deregulate their electricity markets have suffered episodes of major power shortages. A critical question that sector specialists are beginning to ask is whether electricity markets are fundamentally constrained in their ability to provide adequate incentives for investment in generation capacity. In this section I discuss a few of the reform experiences of industrialised countries in order to set the basis for a similar exploration in developing country contexts. The list of country experiences discussed here is by no means exhaustive and is intended mostly to illustrate the many difficulties of electricity reform and establishing electricity markets.

Like most reforms exercises, Britain's electricity privatisation and deregulation were initially and universally eulogised but on many counts the British power pool market, previously lauded for reducing electricity rates and often proffered to reformers in other countries, has not lived up to its promise. A recent review of the programme claims that the government, or more accurately the taxpayers, lost US$ 6 billion in the process (cite). The authors of this study further claim that overall cost reductions were not very significant because the industry was already well-run under state ownership and the gains that were realised through the process were reaped mostly by the shareholders because prices did not fall as much as input costs. The overall impacts in the economy may well have been neutral but distributional concerns were certainly affected: as shareholders, citizens gained a lot and as ratepayers they gained a little but as taxpayers, they generally lost.

Even ratepayers may not really have benefited as many of the claims of price reductions that were previously touted have collapsed under further scrutiny. Comparing pre- and post-privatisation and liberalisation prices in the British electricity industry, Yarrow (1992) argues that the price reductions after the reforms—3.1% for households and 4.2% for industry—are exaggerated because the government, in preparing for privatisation, raised electricity rates by 25% for residential customers and by 19% for industrial customers between 1989 and 1991. Others have argued, perhaps with reason, that electricity prices were artificially low under state ownership and that the price increases were justified in order to bring profitability and rates of return on capital up to levels similar to those prevailing in other sectors. Still other studies (Newbury 1998; Perkins 1996) have claimed that electricity prices would have been even lower in Britain had the old-style regulation continued. Whether or not electricity was underpriced under state-ownership in Britain, it is clear that privatisation did not create any significant price gains for consumers.

Market problems have also assailed Britain's power pool and, in 1998, Britain's electricity regulator was forced to propose sweeping changes to the model. Its review of the pool revealed that it discriminated against coal as a fuel, that the two main generation companies exercised significant market power in it, that it was biased against buyers, that it contained an administered capacity payment that was incompatible with a properly function competitive market and that, overall, the pool inflated electricity prices in the country (Green, 1999; Wolfram 1999; Wolak & Patrick 2001). In response, the government abolished the pool and replaced it with bilateral markets.

A recent evaluation of Norway's electricity reforms indicates that there also many of the early price gains were subsequently reversed. Based on International Energy Agency (IEA) data, Middtun & Thomas (1998) report that household rates, for example, fell 8.2% between 1991 and 1994 after having increased more than 100% over the previous decade. However, in 1995, rates increased by 16.4% to a level 6.5% higher than that in 1991 when the reforms had commenced.

Price comparisons are, inherently, difficult. In Norway, prices may have increased even more had the reforms not been undertaken. In England, the price effects can be attributed also to a variety of other factors such as the age of generation units, the fuel mix employed, and changing technologies. Nevertheless, the initial rosy assessments of electricity reform are definitely more questionable than initially believed.

Over-optimistic initial assessments of favourable movements in electricity rates are, however, not the only problem noted with electricity reforms exercises. More problematic, deregulated electricity markets have corresponded with a decrease in the security of supply. In Norway, for example, Middtun & Thomas (1998) related that many generators were complaining about the financial viability of their investments and were curtailing their investment programmes. Shortly thereafter Norway suffered through an electricity shortage in 1999.

Of all electricity market making efforts, California's electricity fiasco is now a well-researched case (see, for example, Joskow 2001; Joskow & Kahn 2001; Borenstein, Bushnell & Wolak 2002; and Woo 2000) and points to some of the hazards lurking within reform initiatives. In 1993, California's retail rates were about 30% higher than the national average primarily because of sunk costs resulting from investment and procurement decisions made by investors under the regulatory oversight of the California Public Utilities Commission. Advocates of electricity liberalisation in California may have been hoping to shift the burden of these sunk

costs from ratepayers to the shareholders of the investor-owned utilities but the utilities—Pacific Gas & Electric (PG&E), Southern California Edison (SCE) and San Diego Gas & Electric (SDG&E)—had enough political clout to ensure that the eventual restructuring bill would allow them to recover their sunk investments. Consequently, California's 1996 electricity restructuring bill froze retail rates at levels higher than those that would have prevailed had they been based on a simple pass-through of prices prevalent in the wholesale markets. The idea was that these higher rates would compensate the utilities for their sunk costs and that once the utilities had recovered their sunk costs, retail rates could be unfrozen. The logic of this system was based on the universal expectation at that time that wholesale rates would, in fact, remain low or continue to fall and so the utilities would enjoy a larger margin between their wholesale and retail rates. As it turned out, wholesale rates moved in exactly the opposite direction. Utilities were forced to pay ever higher prices for wholesale electricity but because their retail rates were frozen, could not pass on the additional expenses to the consumers. In early 2001, the situation became critical: in February, the California Power Exchange suspended trading; in April, the state's largest utility declared bankruptcy; and between January and May, the state government spent over US$ 7 billion in purchasing wholesale power.

A combination of strategic error in forecasting the movement in wholesale prices, bad market designs including an absence of a contract market, and market power led to the California fiasco. It would be incorrect to conclude that liberalisation per se led to California's problem. A better market design might well have yielded better results. But, the cautionary tale about the dangers of power markets still holds.

On the whole, industrialised country experiences with electricity privatisation, liberalisation and market-making reveal consistent trends, some of which are very positive while others are disquieting. Problems with maintaining security of supply, price volatility, the exercise of market power by large incumbent generators have made it clear that an efficient electricity market does not come about autonomously and that policymakers have to invest time and resources in discovering the right combination of market structures and rules. As a consequence, the transition to competitive markets has taken time and is still incomplete. In the United States, in Britain, in the Scandinavian countries, and in the European Union in general, these efforts are still ongoing more than a decade after they were initiated. The transition, in addition to being long, has been difficult. Markets have not proved adept at incentivising investment in peaking capacity and security of supply has been compromised repeatedly. Worse, it is not often clear whether investors did not invest because the market did not provide them with enough incentives or whether they strategically exploited the market to create scarcities that would push wholesale prices higher.

4. Why are Electricity Markets so Difficult?

If electricity markets have proved difficult to design and maintain despite the technical and financial resources that have been available in industrialised countries, it is because of the technical characteristics of the electricity supply system. There are two main characteristics of electricity that make its markets so difficult. First, electricity has very low demand elasticity because it has virtually no substitute (at least in the short to medium terms). Second, it cannot be stored or inventoried, which means that once capacity constraints are reached, the supply of electricity too becomes inelastic. As a consequence, in scarcity situations where the available

electricity supply is less than demand, or even where it does not significantly exceed demand, market-clearing prices can be pushed to very high levels.

Further complicating electricity markets is the fact that transmission and distribution are still mostly natural monopolies and although some countries have deregulated electricity at the retail level, the results obtained so far have not been uniformly encouraging. In many countries, few except the large customers have shown an inclination to switch suppliers. Competition in the generation sector has proved to be practicable and promising in increasing efficiency and reducing prices. However, if competition cannot be or is not extended to retail markets then the regulation which is required ends up insulating the effect of the competition that does exist in wholesale markets.

Finally, the co-ordination problems of the electricity grid are technically challenging. Electricity supply and demand must be balanced at all times and at all locations in the network, otherwise a failure in the grid will result. More extensive areas are now being interconnected via high-voltage transmission networks. On the one hand this is making possible a more intensive utilisation of the existing physical infrastructure but on the other hand system reliability is becoming an ever more complex task. Systems failures have become potentially extremely costly, a fact testified to by the scope and the rapidity with which blackouts propagated themselves in the United States and Europe in the summer of 2004.

The combination of these technical factors and the failure to adequately anticipate and account for them in a deregulated environment has created many market performance problems. These problems have been exacerbated by the political sensitivity of the electricity sector which forces policymakers to respond quickly and, at least in appearance, vigorously to any problems that might emerge. Often, such interventions in the market lead to administered solutions that worsen the problems they were intended to address or they create other unanticipated problems. A classic example is where price caps act to reduce investment and cause uncertain supplies and even greater upward pressure on prices.

It was because of these various problems with electricity markets that policymakers had traditionally pursued a well-defined set of public tasks in the electric power industry—principally a secure supply of electricity at a reasonable cost—through regulation. Historically, competitive environments were believed to be welfare decreasing given the economies of scale in the industry. Consequently, the authorities allowed electric power utilities to operate as monopolies and pursued public tasks through regulation or public ownership or both. Regulation of the industry was required also to reduce investment risks. Given the industry's high levels of asset specificity, the authorities intended to ensure security of supply by reducing investment risks and guaranteeing an adequate return on investment. Where such systems were owned by government, regulation often took a back seat to more direct administrative interventions in pricing and investment that too sought to pursue the same set of public tasks.

This approach largely did guarantee security of supply in industrialised countries but the inherent weakness of the regulatory and/or state-ownership approaches were often said to contribute to overbuilding, cost-overruns, and pharaoic projects. Contributing to the dissatisfaction, many studies found regulation to be unsatisfactory in achieving its stated objectives. Amongst such studies, for example, Stigler and Friedland (1962) concluded that regulation in the electricity industry was ineffective in reducing revenue per unit of power sold and in reducing the amount of price discrimination between domestic and industrial users while

Moore (1975) found that regulation was not only unsuccessful in reducing rates but, perversely, contributed to raising them. As a result, a growing segment of the policymaking community began to believe that the security of supply was costing more than it needed to and, in response, policymakers have been turning to markets hoping that they will better achieve the objectives that regulations were intended to achieve.

Although they are inherently complicated, what policymakers and consumers want out of electricity markets is a continuation of the public tasks that they have been pursuing through regulation and public ownership. Consequently, electricity markets are supposed to perform three primary tasks. First, electricity markets should allocate energy efficiently. Second, electricity markets should promote competition amongst suppliers so that efficiency is maximised and prices kept as low as possible. Third, electricity markets should provide the correct signals to investors so that they make timely investments in capacity expansion and thereby provide a sufficient and reliable supply of electricity.

As this paper focuses on decisions that lead to investment in capacity expansion, it will first analyse theoretically and practically how electricity markets function, contrasting between developed and developing country situations. In the sections that follow it will contextualise these arguments to the Brazilian case.

4.1. Behaviour of Prices in Electricity Markets

Price setting and investment in electric power can be governed by many mechanisms, including various forms of market or government authority. At one end of the spectrum, it is public authority that co-ordinates economic activity, forcing the individual players to operate according to specific directives that are established by the authorities' conception of the public interest. Deregulation or liberalisation, as the terms are used in this paper, means shifting from a reliance on regulation as the principle mechanism to achieve public task goals to a reliance on competitive markets to deliver the same desired results. Shifting from administered and regulated environments to competitive and market environments entails changing both economic objectives and the methods of allocation. The dominant economic objective in the administered or regulated form is maximising the public's interest whereas in the classical market system it is maximising the individual's profit. Consequently, while output and consumption are determined by planning in regulated environments, it is the price mechanism which determines these variables in the market system. In regulated environments, furthermore, prices are generally based on estimates of average costs while in the market system prices are most often derived from marginal costs.

As described in the previous sections, most electricity markets have been designed as commodity markets where marginal pricing or market-clearing pricing rules are used. This results in all sellers receiving a uniform price, regardless of their costs of production. Many have criticised such market designs because they allow sellers who have low production costs to receive the much higher market-clearing prices. This condition is, however, true for all commodity markets and is neither a design flaw nor an expression of market power. Intervening administrative to change the remuneration rules to pay only the bid amount to generators would not necessary lead to lower prices. In such cases, low-cost generators will logically no longer continue to bid their marginal costs into the system but will, instead, estimate the likely demand and the approximate costs of the marginal generators and bid at levels just below this to ensure that they are dispatched. There might be a confusing period of transition during which generators

will begin to learn about demand levels and the costs of their competitors, but eventually markets for such information will establish themselves.

Fundamentally, there are two types of wholesale electricity markets: real-time spot markets in which producers and consumers transact in a commodity-type market and where prices vary by periods such as the half-hour or longer term bilateral contract markets where producers and consumers directly negotiate prices and quantities over periods stretching into years. Theoretical approaches have suggested and empirical research has confirmed that the former type of market is more prone to price volatility.

In the spot markets, if the supply situation is tight then prices naturally migrate to those based on the costs of the most expensive plants that need to be dispatched. The situation may be exacerbated if generation capacity is concentrated within a few firms which can exercise market power. With market power, sellers can bid above their marginal costs or even take some of their plants out of production during peak demand times, making the supply situation even tighter and pushing prices up even higher.

Volatility is also exacerbated because, unlike other industries such as telecommunications or airlines where capacity can be adjusted and demand is responsive to price changes, there is little demand or supply elasticity in the electricity market. Furthermore, unlike telecommunications for example, where capacity shortages lead to something as innocuous as a temporary busy signal, shortages or imbalances in the electricity sector lead to very costly and disruptive blackouts.

Bilateral contracts markets in which buyers and sellers lock in prices and quantities over a period of time are less volatile because periodic shortages and surpluses are smoothed out. Even though bilateral contracts markets are less volatile, they are not necessarily cheaper. It is unlikely that the average prices in spot and bilateral markets will differ significantly because if they do then it would create arbitrage opportunities. Therefore, even if the spot market accounts for a small fraction of total power contracted it should still act as a signal for prices in all wholesale power markets. If, for example, power obtained through long-term power contracts is consistently and significantly cheaper than that which can be obtained through the spot market, then buyers would naturally migrate to the long-term markets raising its prices and lowering them in the spot markets and vice versa.

In both spot and bilateral markets, the fundamental undesirable characteristic is that prices are determined by the most expensive plant that must run. This means that all of the low cost plants may earn significant economic rents. Regulation and public ownership, theoretically at least, avoided this situation because each plant was remunerated according to its cost. Assuming that productive efficiencies are comparable under regulation and competitive markets (which is often not the case) average cost pricing differentiated by plants would yield lower market prices when supply is tight because the costs of the marginal units will be extremely high. The prices in the competitive (unregulated) market would be even higher if some producers exercise significant market power and are able to price above marginal cost. On the other hand, if surplus capacity exists, marginal costs will be well below average costs because the most expensive plants will not enter the equation. In such cases, the price in competitive markets may be lower than the price that regulated markets would produce.

Thus, how well competitive wholesale markets meet the expectations and satisfy the desires of policymakers and customers depends upon what the supply conditions are. If supply is plentiful, governments and customers will prefer the outcomes of competitive markets. From only a pricing perspective, it should not matter much whether the electricity is traded primarily in spot or long-term bilateral markets as the average prices in both will tend towards the same value.

4.2. Investment in Deregulated Markets

Our interest now shifts to how well the various market governance mechanisms work to promote investment in generation capacity, especially that of peaking plants. Peaking supplies are important because they play a critical role in maintaining reliability during high demand hours and also provide a cushion against unexpected outages in base-load plants. The problem with peaking plants in a competitive market system is that they may run only infrequently.

Investors will invest only if they expect to make an acceptable return on their capital outlays. Theoretically, therefore, to recover sunk or fixed costs, high-cost firms or plants would have to set prices above their marginal short-run costs otherwise peaking capacity would never cover its capital costs. Thus, periods of high prices are particularly important to the profitability of peaking plants. Orthodox market proponents therefore recommend that no constraints be placed on market prices, explaining that price spikes reflect scarcity more than market power and any attempts to limit prices would only make the supply situation worse.

Regulated markets, with an implicit guarantee of returns on investment were effective in promoting investment in generation; indeed some scholars even faulted them for promoting over-investment (Averich & Johnson 1962). Competitive markets—generally seen as a cheaper alternative to regulation precisely because they discourage over-investment and other inefficiencies—have, however, demonstrated problems in promoting timely and adequate investment in generation.

In competitive electricity markets, if it were left to price signals then investment in electric power generation facilities would be quite jerky, prone to repeated episodes of shortages and surplus. First, it takes time, even after the market signals investment, for new capacity to be built. Generation plants have long lead times. Fossil fuel power plants generally take about two years to build while hydroelectric plants can take between three to six years to construct. Time and cost overruns are also frequent occurrences in power projects. As such, supply cannot adjust rapidly to changes in demand.

Second, the market signals are themselves delayed. Power generation is a capital intensive activity, which is to say that it has high fixed costs. This means that the marginal system prices are frequently less than average costs. When the supply situation is comfortable and sufficient surplus capacity exists, firms will produce and sell as long as the market prices are above their marginal costs and prices are likely to be much below the average costs of the marginal generating units. The main problem with this situation is that such marginal cost pricing will not allow such plants, which do not form part of the base-load capacity, to recover their fixed costs. As such, price signals to incentivise investment will not be sent until such time as the supply situation becomes fairly stressed. As a consequence, investment in generation capacity will be lower and slower than desired from the systems reliability perspective. Generally, increasing capacity utilisation should lead to a sufficient and sustained increase in the

general level of prices that would make investment in new peaking capacity economically attractive but this would occur only after the supply situation had already become tight. Furthermore, once the new capacity is created and a degree of supply surplus obtained, prices will again settle down to levels where it would be uneconomic to further increase capacity and the cycle would repeat itself. Thus, investment in power generation facilities would be lumpy.

This does not augur well for security of supply. If the long-run marginal costs can be reached only at close to full capacity utilisation, then investors are unlikely to create significant reserve capacity and the industry will be operating for extended, undesirable, periods of time at the capacity frontier. Given that it is normal for plants to be taken out for maintenance, scheduled or unscheduled, the risks of supply disruptions in such situations would be unacceptably high.

The existing base of power plants also affects investment patterns. If the marginal costs of new plants are less than those of the old ones, then, as they cede market space to the newer cheaper entrants, the old plants may be mothballed or shifted to peaking production. In this situation, few problems arise if the capital costs of the old plant is already amortised. However, if the capital costs are not amortised, then a stranded assets problem is created which, like the plants in California and the nuclear plants in the UK, require an administrative solution.

If, on the other hand, the new facilities are more expensive than the existing facilities, it will be much harder to get investment without some form of regulatory intervention that compensates generators for making units available even if those units do not run. The objective of such intervention is to provide investors a return based on their average and not their marginal costs. One simple form for compensating investors when their plants run too infrequently to be profitable is to create a system of capacity payments made to owners of generation plants to make them available on a stand-by basis. In England, for example, the systems operator determined capacity payments based on an estimated loss of load probability (LOLP) and a value of lost load (VOLL) which was set by the government. All generators that made plant available would be paid the capacity payment, which was calculated as LOLP x (VOLL-SMP), where SMP was the marginal system price. These payments tend to increase the security of supply but they also raise the average price of electricity.

Thus, like the prices discussed in the previous section, investment behaviour too is context specific. If new investments are likely to be more competitive than the existing plants, then installed capacity will increase as the older plants are replaced by newer and cheaper ones. If the contrary, then other financial incentives will need to be offered in order to ensure sufficient investment in peaking supplies.

4.3. Partial Deregulation and Regulatory Uncertainty

In competitive markets, electricity shortages can result both if new plants are more expensive than existing ones and if investors are pessimistic about future demand. Since demand itself cannot adjust quickly in the face of supply constraints and because consumer willingness to pay for uninterrupted electricity supply can be high, prices can skyrocket. Furthermore, even with skyrocketing prices, it takes time to construct new capacity and supply shortages may not be avoided till such time as prices reach such stratospheric levels that a big chunk of demand is actually priced out of the market. If, as in California, retail consumers are protected from price variations, then shortages cannot be avoided even by massive price increases in wholesale markets.

The previous sections have illustrated how competitive wholesale electricity markets may not provide adequate capacity. In such scenarios, various forms of regulatory and administrative interventions become necessary. Indeed, many policymakers themselves have been agnostic about the market's ability to provide an adequate supply of electricity and have attempted to blend regulation and competition in order to combine the advantages of the two forms of governance. With more markets then, ironically, more regulation is required to ensure security of supply and reasonable prices. These regulations are complex both because they attempt to harmonise regulation with competition and because competition itself is difficult to promote across the industry. Whereas in an ideal electricity market there would be price competition in the entire productive chain of the industry, the structure and technical characteristics of the electricity industry are, however, hampering efforts towards full deregulation and, as Stigler (1952) put it, "an industry which does not have a competitive structure will not have competitive behaviour."

Full deregulation, some have argued, would take care of market problems because the problems with competitive electricity markets has not been too much deregulation but too little liberalisation. Such opinions castigate policymakers for being too timid. However, a certain degree of timidity in electricity deregulation is well-founded because, as Joskow (1997) noted:

> "(o)nce a state removes a utility's traditional obligations to serve, required unbundled rates, provides open access to the network, gives retail customers a choice, deregulates generation prices and entry, and requires utilities to divest a significant amount of generation capacity (or through breaking up during the privatisation process), it will be very difficult for a state commission to turn the clock back."

Almost all electricity market reform programmes have experienced problems at the outset and mid-course corrections have always been necessary to mitigate market performance problems. When problems emerge, government officials are under pressure act quickly and decisively to fix the problems. Evolving initiatives to remedy serious market performance problems should therefore be an expected feature of the prices of creating efficient competitive wholesale electricity markets.

Although it may be inevitable until the right mix of market and regulatory control is found, such frequent fiddling with the rules can by itself discourage investment. It threatens regulatory credibility, especially in developing countries which do not have a history of regulatory independence. In volatile situations, investors may actually anticipate future regulatory interventions (which will frequently be to their disadvantage) and enter a holding pattern, which itself forces the intervention that they had feared. The lack of regulatory credibility thus becomes a self-fulfilling prophesy (Kydland and Prescott 1977). For example, substantial investment occurs when there are substantial profits to be made. If prices rise as a consequence of restructuring, and there is evidence of high profits, then there is bound to be scrutiny and calls for administrative intervention. If investors, fearing price controls, resist from making new investments and the supply situation worsens as a consequence, prices will rise even more and put additional pressure for governments to intervene with price controls. Thus, given the politicised nature of the electricity industry, the problem is that benefits will only occur in the long run as the structure of the industry slowly evolves, but short-term problems and policy pressures can derail the processes of reform.

5. Structure and Peculiarities of the Brazilian Electricity System

Thus far this paper has argued a general case based on the experiences of developed countries. The paper's focus will now shift to Brazil's experience with developing electricity markets. In 1993, Brazil began reforming its electric power sector. Before the power reforms, price setting was based on the traditional rate of return regulatory model in which electricity rates, theoretically at least, reflected the utilities' incurred costs plus an allowance that would allow the utility to earn a pre-defined rate of return on assets.[37] In initiating the reforms, Brazil passed of a series of laws that were intended to allow more market oriented pricing policies. Privatisation of the industry began in 1995 with the auction of distribution concessions. At the beginning of the privatisation process, the policy did not force vertical separation but did restrict distribution companies to self-supplying a maximum of 30% of their requirements. To prevent market power, generation companies were restricted to a maximum share of 35% in their regional market and 25% nationally. In 1998, Brazil introduced its version of a spot wholesale electricity market (MAE) and bilateral contracts markets. According to the new Brazilian electricity policy, distribution companies had to contract for at least 85% of their load via long term bilateral supply contracts. The spot market would, therefore, cater to only a small proportion of the overall electricity market.[38] On the retail end, new customers whose power requirements exceeded 3MW and existing customers whose demand was over 10MW were free to purchase power competitively and the policy envisioned a gradual relaxation of these limits.

5.1. Structure and Planning in Brazilian Electricity

A background knowledge of the structure of Brazil's electricity industry is critical to understanding how its electricity reforms and markets were constructed and in this story the effect of hydropower looms large. Brazil is one of a few large countries where hydropower is the dominant source of electricity. Large hydropower schemes became Brazil's technology of choice for electricity because of favourable geographic factors, the country's chosen economic growth strategies and subsidised capital. In terms of installed hydropower capacity, Brazil now ranks behind only the United States and Canada and, with over 90% of its electricity needs being supplied by hydroelectric plants, behind only Norway in terms of its dependence upon hydropower.

Even compared to the other major hydropower producing countries, Brazil's electricity structure is somewhat unique. First, Brazil's hydroelectric reservoirs are rain-fed and the rainfall patterns vary considerably from year to year. As such, Brazilian power engineers designed hydropower dams with very large reservoirs so that the system could withstand even several years of drought. Second, in Brazil very often several dams have been constructed in a cascade on the same river and, frequently, these dams are owned by different generation companies. Since the production decisions of any one plant impacts the production capabilities of all the

[37] Although the 1934 Water Code guaranteed a minimum 10% return on assets for electric power utilities, successive governments often did not adhere to this provision. Whenever demanded by economic pressures, primarily inflation, governments generally suppressed electricity rates.

[38] Brazilian power reforms have been treated in greater detail elsewhere and this paper will provide only a brief overview of the reforms.

other downstream plants, in order to optimise electricity production the generation from these various plants has to be co-ordinated

The fact that Brazil's hydroelectric system functions on a pluri-annual basis fundamentally affects the manner in which capacity constraints and security of supply are determined. To illustrate, let us take the example of a power generation infrastructure based predominantly on thermal power plants and assume that there are no problems with the fuel supply, be it coal, gas, diesel or nuclear. In such a case, capacity is constrained if during peak consumption hours or during peak consumption months, the sum of the plants running at full capacity (taking into account normal outages for maintenance, etc) is unable to supply the total amount of power demanded. This would necessitate as immediate measures the adoption of rationing or of rolling blackouts or brownouts in order to reduce the effective demand or, if a market-based measure is preferred, the raising of prices to levels high enough to price out enough demand from the market. This shortfall in capacity can be eliminated only by constructing additional power plants, for which high prices in wholesale electricity markets should act as an incentive. In Brazil, however, capacity constraint is not directly determined by the installed capacity but rather by the previsions of the stock of water (the fuel) in the reservoirs, which being dependent on rainfall cannot readily be replenished. If reservoir levels are healthy and there are favourable previsions for rainfall in the future, then supplies are considered plentiful and capacity is not constrained. On the other hand, if reservoir levels are low and the previsions are for only scant rainfall, then capacity would be considered severely constrained. These two diametrically opposed conditions of plenty and scarce may be encountered even with the same demand levels and installed capacity. Installed capacity in Brazil is, therefore, always capable of meeting demand at any given point in time and power is considered scarce only when the system, if it were to continuously satisfy all the demand, would eventually run out of water before the rains came.

To determine if installed capacity is, in fact, sufficient, electricity planners in Brazil had to adopt a unique set of criteria. Since rainfall in Brazil is inherently and substantially erratic, engineers from Eletrobras—Brazil's federally-owned power generation holding company—devised a probabilistic system in which installed capacity is considered sufficient if the available power generation infrastructure is able to guarantee supply of all demand in at least 95% of the rainfall scenarios simulated each year. In other words, of the various hydrological scenarios simulated it is expected that supply problems will occur in less than 5% of the scenarios. This 5% risk of shortages was, according to the Eletrobras planners, the appropriate trade-off between security of supply and cost.[39] To reduce the risk further would require the construction of so much surplus capacity as to render it uneconomic. If the risk of shortages exceeds 5%, then additional capacity is required in order to relieve the pressure on existing reservoirs.

The primary objective of the electricity dispatch system in Brazil is to optimise the country's hydropower resources. This optimisation consists of two discrete tasks. The first task is to maximise the amount of hydroelectricity generation potential via co-ordinated production decisions. The second task is to determine how much thermal power to produce in conjunction with the hydropower.

---

[39] In the 1970s, the rainfall scenarios were based on the assumption that the worst recorded drought might reoccur. This was updated later to incorporate a considerably larger number of theoretical rainfall scenarios produced by a probabilistic model.

As mentioned above, in Brazil there are often several dams owned by different generation companies lined up on the same river system. Consequently, the production decisions of any one plant create positive or negative externalities for other plants. A simple illustrative example will make this point much clearer. Assume that there are three different plants on a river, A downstream from B which itself is downstream from C. Assume also that the reservoirs of A, B, and C are full. Now if in period 1, when the opportunity cost of water is low, C decides to bid low enough to be dispatched, A & B will also be forced to produce in order to create space for the water coming in from C's reservoirs and given this surplus production, the price of their power will be more or less zero. In this scenario it would be more efficient for A to produce first, empty its reservoirs, then B to produce, thereby refilling A's reservoirs, followed by C, which would refill B's reservoirs and so on. Thus, the same volume of water stored in C's reservoirs produces electricity three times: at C, again at B and again at A. During times of water scarcity, it becomes even more important that the reservoirs be operated in a co-ordinated manner. As a matter of fact, Eletrobras had estimated that not operating the reservoirs in a co-ordinated manner would require an additional 30% of installed capacity in order to produce the same amount of electricity.

Similarly, the scenarios of hydropower production developed by Eletrobras dictated the thermal power production decisions. Because the actual marginal costs of producing hydroelectricity are extremely low, the preference is always to avoid generating power from thermal plants as much as possible. As long as reservoir levels and previsions for rainfall are favourable, then the opportunity cost of producing electricity from hydroelectric plants versus storing the water for production at a later date is low and the systems operator would not dispatch power from thermal power plants. Thermal power plants would only be dispatched in cases of water shortage and, theoretically, for the minimum amount necessary to carry the system into the next period of rainfall. Using the 5% risk of shortage criteria established by Electrobras, this would mean that the systems operator would seek to dispatch the minimum amount of thermal power that would ensure uninterrupted electricity supply in 95% of the rainfall scenarios calculated for the period in question. It is for this reason also that although hydropower represents about 90% of installed capacity, hydroelectricity comprises over 95% of the electricity actually produced in the country. Most thermal plants, therefore, are run quite infrequently except in the regions isolated from the nationally linked electricity grids.

5.2. Price Setting in Brazil's Electricity Industry

Price setting in the Brazilian electricity industry was based on the same general principles as other electricity industries but were adapted to the structural peculiarities of the Brazilian power infrastructure. Before the reforms, Brazilian power prices—when the economic and political situation allowed[40]—were based on rate of return regulation where prices are set to compensate the owner for all the operational costs plus a pre-determined return on capital. After the reforms, the Brazilian system was loosely based on the British model, with its spot and bilateral markets. There were, however, some fundamental differences between the two. Prices in the British power pool were the market-clearing prices. The British systems operator would dispatch plants based on their bid values until all demand was satisfied. The price all producers would then receive would be what the last (most expensive) plant dispatched had bid. This bid value, theoretically, was the system marginal cost. The prices in the Brazilian wholesale market,

[40]Generally, Brazilian electricity rates after 1978 were kept low as an inflation control measure and the electricity firms generally ceased to make adequate returns on investment.

the MAE, like the spot prices in the British pool market, intended to represent the system marginal cost at which supply and demand are in balance but, unlike in the British spot market, there was no competitive price bidding by hydropower generators to sell in this market. Instead, it was the ONS that determined the dispatch scheme and the price using calculations based on probabilistic models that estimated the opportunity cost of using water to produce electricity in the present versus in the future.

The requirement to maximise the potential hydroelectric generation, as discussed in the previous section, was the main reason that hydropower generators were not allowed to bid competitively into the system. Given that hydropower generators were not given any control over their own production decisions, a unique payment scheme was devised for them. First, the National Electric Power Regulatory Agency (ANEEL) would calculate the total amount of assured hydropower in the system and then issue assured energy certificates (CEA) to each generation firm in proportion to its share of total potential generation capacity. Then, of the total volume of hydropower dispatched, the generation firms are paid in proportion to their share of the total CEAs. Thus, for example, a particular firm may physically supply 50% of the electricity produced in a given period but if its CEAs amount to only a 40% share of potential production then it would receive only 40% of the total hydropower revenue for that period.

The idea behind this payment scheme was that in a later period this firm would produce less than its designated share and be compensated for this lost revenue. The Energy Relocation Mechanism (ERM) was devised to operationalise this idea. It allocated output from plants that produced less than their share of assured energy to those that produced more. Thus, ERM guaranteed hydropower producers their assured energy entitlement, provided that in aggregate the hydropower generators produced enough to meet their total assured energy commitments. If the total hydroelectric production is greater than the CEA then the surplus, known as secondary energy, would be shared by all hydropower generators. If the total hydroelectric production were less than the CEA, then it was incumbent upon hydropower producers to purchase the power deficit in the MAE. Again, all hydroelectric producers were equally exposed if, as a whole, they had to secure power in the MAE. This dispatch and payment scheme, it was expected, would eliminate many of the incentives hydropower generation firms may have to ignore the ONS' real time dispatch instructions. What this resulted in was a centralised production decision which, although necessary to optimise production, meant that risk management on the part of the market participants was absent.

Since hydropower producers, who produce about 95% of the total electricity consumed, have no control over their pricing and production decisions in Brazil, the MAE could not be bid-based. As such, the system marginal price had to be calculated differently. For the hydroelectric generators, the marginal price was calculated as the opportunity cost of producing the electricity at the present time or at some point of time in the future. This price was, therefore, a probabilistic determination of the likely reservoir levels in the future.

The system marginal cost was then used to decide the production of thermal power. All the thermal power generation facilities were required to submit production cost data to ONS and using this data ONS uses a stochastic dynamic programming model to determine how much thermal power should be dispatched and from which units. If the system marginal price as calculated by the ONS were higher than the marginal cost of the thermal plants, then they would be dispatched in a manner similar to the British system with the lowest bidders dispatched first. Unlike the hydropower units which would receive compensation based not on their actual

production but rather on their share of total potential production, thermal facilities would be paid for their share of actual production.

With the physical dispatch complete divorced from the financial transactions and contracts, in and of itself, the Brazilian MAE was not designed to play a significant role in electricity trading, price-setting or incentivising generation investment. The Brazilian electricity policy required distribution companies to sign long-term power supply contracts with generators to supply at least 85% of their estimated demands. As such, it would only be small amounts of non-contracted energy that would be traded in the MAE and settled at the MAE prices. However, with the proposed liberalisation of retail markets, MAE would inevitably come to play a greater role.

The wholesale price of electricity in Brazil would be established principally in the bilateral contracts market. Initially, the government had locked this price for eight years. To prepare the industry for the transition to a private and competitive environment, the government had required all generation companies to sign a set of initial contracts with their corresponding distribution companies. The volumes of these contracts were set to reflect the level of assured energy that the generators could supply (based on the 5% risk of deficit criterion) and the prices were set to be in line with those in the existing regulated supply contracts. These prices would remain constant through the life of the contracts but they would be adjusted for inflation. The initial contracts were supposed to last eight years, with 100% of the generators' assured energy covered for the first four years. Then, over the following four years, 25% of the volume would be liberated each year, to be freely negotiated between generators and consumers. Thus, after eight years, all wholesale prices would be deregulated and established in competitive markets. On the retail end, the Brazilian power reforms again borrowed from the British system. Distribution companies were allowed to fully pass-through to the customers the cost of wholesale power procurement subject to a price cap (called Normative Value or VN) established by ANEEL. The distributors' own costs were regulated by the common RPI-X system.

6. Mischievous Markets

Before the reforms, most of the technical decisions regarding investment and dispatch were made by the public sector with a view to ensuring that Brazil's electricity industry was run efficiently and fulfilled the public tasks assigned to it. This approach was widely criticised as inefficient and expensive. Critics blamed the public ownership of Brazilian electric power assets for the sector's high levels of debt and its inability to invest sufficiently to keep up with demand increases. Brazil's power reforms, motivated initially by the need to ramp up investments through privatisation, sought to eventually assign to the market the tasks of providing an adequate and efficient electricity infrastructure.

Making electricity markets is a complex task, but from its inception, creating the Brazilian power market was an especially complex undertaking. It required high degrees of regulatory and administrative intervention in its day-to-day functioning. Brazil's electricity industry planning methods and structures, which had been developed when it was state-owned and centrally controlled, had to be adapted to a new decentralised, privatised and competitive environment. In the process of doing so, the government had to balance competing economic demands that were pulling the reforms processes in different directions. This section analyses the

actual effects and potential impacts of the proposed reforms on prices and investment in the Brazilian electricity industry.

6.1. Price Signals

Prices in almost all types of spot electricity markets are volatile but in Brazil they are especially so. Since the Brazilian hydropower system was designed to attend demand even in situations of severe drought, for most of the time there will be a significant supply surplus and consequently the opportunity cost of water in the hydropower reservoirs and the price of electricity in short-term markets will be extremely low, more or less equal to the few dollars it costs to open and shut sluice gates in the dams. Only in a very limited number of occasions would the available hydropower be unable to attend all of the demand. In even fewer occasions would supply approach its limits. Electricity prices in Brazil would therefore generally remain low but when supply limits are reached the prices could potentially spike up to extremely high levels (see Figure 1).

This form of volatility in the Brazilian electricity system seriously limits the ability of spot markets to be useful in signalling new investments. With prices remaining so low for most of the year, or even for consecutive years, most new plants would be unable to recuperate their fixed costs. This limitation of short-term competitive markets was recognised during the Brazilian power reforms process. Consequently, the government initially made it compulsory for distribution companies to contract for at least 85% of their power requirements through long-term bilateral contracts. It was expected that this necessity to contract would provide the basis for generation capacity expansion. If a distribution company anticipates an increase in its demand, then it would contract for power with the most competitive supplier, who would then, in turn, be able to use the power purchase agreements to obtain project finance.

In a static analysis, these provisions appear sufficient to guarantee adequate capacity expansion. However, the proposed full deregulation of retail markets sometime in the future would contaminate the investment decisions. Although the initial policy focus was on privatisation, Brazil's policymakers intended to segregate the power industry into four segments—generation, transmission, distribution and retail. The wires business—transmission and distribution—would have to be regulated as natural monopolies but competition would be introduced, first in generation and then in retail markets. Initially, the distribution companies were awarded exclusive retail franchises, but the Brazilian electricity policy intended to split them into distribution and retail functions and fully liberalise retail markets after a period of transition.

After introducing retail level liberalisation, Brazilian policymakers would no longer be able to mandate such requirements as contracting 85% of total demand and the system of compulsory contracting between distribution companies and generation companies would become untenable. A regulator could certainly not require distribution companies to sign long-term power purchase contracts for a certain pre-defined load if its customers would be free to switch suppliers. Retail suppliers could no doubt sign such contracts to lock-in wholesale prices for themselves and many might do so but they would have to do so based on their own assessments of risk. However, given the extremely low levels of prices prevalent in spot markets for most of the time in Brazil, there would be a strong incentive for retail firms to procure directly in the spot markets, with perhaps financial hedges for those occasional periods of price spikes. Retail firms that locked themselves into power purchase contracts at higher prices risked

seeing their customers migrate to other operators procuring power directly in the spot markets. These strategies would, therefore, hinder the supply of financing for generation investment. Deregulated retail markets that could work could no doubt be designed for the Brazilian market but they would require extremely well thought out and detailed governance structures. Given the rapidity with which the industry was being privatised, the time and resources required to create these structures had not been invested.

6.2. Investment Decision Distortions

Competitive markets generally offer few opportunities for peaking supplies to recover their capital costs (unless there are specific administrative or regulatory provisions—such as capacity charges—for investors to be compensated for their capital independently of the prevailing wholesale prices). In such cases, investors favour plants with lower capital costs which allow them to recover their fixed costs more easily (Teisberg 1993). The trade-off that the investor makes in this case is that the plants with lower fixed costs will generally have higher operating costs. If the plant with lower fixed costs also has lower total or average costs, then the investment is efficient from the long term perspective. However, if the contrary, then the investor sacrifices long-term efficiency in exchange for lower capital exposure. As a consequence the average electricity prices will tend to be higher. In effect, this type of strategic decision-making could cause the industry supply curve to shift upwards.

In the Brazilian case, the trade-off which investors had to make was between thermal and hydroelectric plants. The difference between their capital costs was substantial. Thermal power plants generally cost US$ 600 per kW of installed capacity whereas hydroelectric plants could cost anywhere between US$ 800 to US$ 1,200 per kW. In spot markets, hydroelectric power would no doubt be more competitive since it has an operating or marginal cost of about US$ 5 per MWh whereas thermal plants, depending on fuel costs, have an operating cost around four times as much. If given the much higher capital costs of hydroelectric plants their total costs would be higher than that of thermal plants, then an investor preference for the lower capital cost option would be economically efficient. However, in the Brazilian case, average costs per MWh of thermal plants were almost 20% higher than those of hydroelectric plants (approximately US$ 39-41 per MWh for thermal versus US$ 32-34 per MWh for hydro). As such, even from the long-term perspective, hydropower plants were more competitive.

Because investors were apprehensive that they would enjoy few opportunities to recover their capital costs in a competitive Brazilian power market, they preferred to invest in thermal over hydroelectric plants. Their preference was temporarily shared by the government because of the tenuous power supply situation. Thermal power plants can be brought on-line much faster than hydropower plants and were therefore preferred for the immediate future despite their higher costs. This preference, combined with the investors' own concerns, led the government to create the Priority Programme for Thermoelectric Power (PPT), which intended to add over 18 GW of installed capacity between 1999 and 2003 by constructing almost 50 new thermoelectric plants.

In purely competitive markets, it was not possible for thermal power to compete with hydropower. A short-term measure that ANEEL created to overcome these market-based constraints was that they allowed distribution companies which contracted with thermal power producers to pass-through a greater wholesale charge. To do so, ANEEL established a VN of R$

61.80 for thermal power supplies as opposed to a VN of R$ 57.20 for "competitive" or hydropower supplies. This measure could only work as long as retail markets were monopolistic and regulated. Should retail markets be liberalised, retail commercialisers would cease to contract with the more expensive thermal power supplies. Even if regulators would put restrictions on how much hydroelectric power could be sold through bilateral contracts in an effort to stimulate the sale of other types of power, retail commercialisers would still find it advantageous most of the time to source the excess hydropower directly in the spot markets.

This does not mean that the more expensive thermal power supplies had no place in the competitive electricity markets. Thermal supplies would be needed as peaking power. However, it would be very difficult for them to find parties willing to sign long-term take-or-pay power purchase agreements in a deregulated and competitive environment. In such an environment investors, lacking the assured cash-flows of power purchase agreements, would then find it difficult to obtain project finance, which in turn would make it difficult for peaking supplies to be constructed.

From any other than the short-term perspective, the PPT was logically flawed. In reality, however, the programme failed to take off not because of longer term strategic inconsistencies but because of short-term commercial problems. The immediate problem that confronted the PPT was that the initial contracts that the distribution companies were required to sign with the generation companies covered 100% of the former's power requirements between 1999 and 2001. As such, there was no commercial space in which the PPT plants could sell their power even though there was a physical necessity for the new power. This created an asymmetric risk for distribution companies. They believed that their initial supply contracts with generation companies protected them from financial exposure in the event of a power shortage. If they did contract for additional power and there was no shortage, then they would be left financially exposed since the ANEEL would not allow them to pass through to the customers the costs of the extra power contracted. Even if the commercial space had been available for investors to contract with distribution companies, there were other economic problems with the PPT. One of the most critical of these problems was that PPT plants were to be fuelled by natural gas, which had to be imported and paid for in dollars. Since the Real Plan forbade linking utility rates to the dollar, this created significant exchange rate risks for the thermal power operators. Furthermore, given the prevailing natural gas prices, the VN established by ANEEL was in any case too low to allow the thermal power plant operators to make an acceptable return on their investments. An alternative option to construct the PPT plants as merchant plants which would sell directly in spot markets was deemed too risky by the investors.

Although the idea implicit in the PPT was that private investors would build the plants largely using their own resources, eventually the Brazilian government had to intervene forcefully to stimulate investment through its various agencies, including Petrobras and Eletrobras. Despite the original incentives offered by the PPT—mainly low cost lines of credit with BNDES—the economic risks of the undertakings made them unattractive to investors. Once it realised that the amount of energy it was seeking through the private initiative would not be realised, the government adopted a series of measures to turn these projects viable: it reduced the average price of natural gas for the thermal generators, it created long term gas purchase contracts between the seller (Gaspetro) and the buyers, it established a loow-interest line of credit with BNDES and it revised the VN to an even higher level. These measures alone were not sufficient to overcome the investors' qualms. Eventually, the PPT took off, in a modest way, but only after the government essentially guaranteed the purchase of the PPT plants' power by

Eletrobras and used Petrobras as a strategic investor in most of the plants. In effect, the government abandoned market principles and returned to administratively devised frameworks and state-provided financing to ensure sufficient investment in electric power generation capacity. This negation of market principles was forced by the political compulsions of ensuring an adequate supply of electricity and by the technical and economic complexities of the markets themselves.

6.3. "Old" versus "New" Energy

Another complication to electricity markets was caused by the existing electric power infrastructure. Even though most of Brazil's power would be traded through long-term bilateral contracts and thereby would be insulated from the volatility of the spot markets, introducing competition and, by extension, the freedom for producers to receive the marginal system cost for their output would lead to a massive increase in the average price of wholesale power in the country. A substantial portion of Brazil's hydropower was supplied by plants whose capital costs had long been amortised. Prior to the reforms, these plants were supplying electricity, or "old energy" as it came to be called in Brazil, at their very low operational costs of around US$ 10 per MWh. If all of these plants were to sell at the marginal costs of the "new energy"—US$ 32-34 for new hyrdo and US$ 39-41 for thermal power—then the average wholesale electricity prices would rise tremendously. To avoid rate shocks and smoothen the electricity industry restructuring, the government decided to lock in the low rates of "old energy" through compulsory initial contracts.

The government's dilemma was deciding how long to keep these rates frozen. One segment of the government was concerned that as the initial contracts expired, an increasing proportion of consumer bills would reflect the market clearing price rather than the significantly lower operating costs of the amortised generation plants. Thus, liberalising these rates would lead to a big increase in average electricity rates and push up inflation rates in the general economy. Calculations made by a government committee established on the eve of the electricity rationing indicated that with deregulation the average wholesale price of power would nearly double from R$ 51 per MWh to R$ 97 per MWh between 2001 and 2006 and, as a consequence, average retail prices would increase from R$ 124 per MWh to R$ 170 per MWh over the same period (MME 2002).

Another segment of the government was keen to maximise revenues from the privatisation process and thereby reduce the government's debt load. If the rates were to be liberalised sooner rather than later, the state-owned generation companies would be more valuable to investors. Liberalising the rates too soon, however, would lead to such large rate increases that they would not only drive inflation but might also create popular and political resistance to the electricity reform process. Indeed, the consultants hired by the Ministry of Mines and Energy to chart the transformation of the Brazilian electric power industry had recommended a much longer transition period of 15 years with small amounts of amortised power being liberalised only after six years (Coopers & Lybrand 1997). The government, however, decided to shorten this transition period to eight years, with one-quarter of the amortised power being liberalised every year from the fourth year onwards.

What to do with this amortised energy was one of the most important trade-off decisions that the government had to take. It might have preferred maintaining a certain degree of ambiguity about its plans if that would raise the sales prices of the firms during their privatisation

processes. But, dealing with the "old energy" issue was unavoidable. Although the government's officially stated policy was that after the transitional period wholesale power rates would be fully determined by the market, to the investors it did not appear very credible that the government could remain impassive in the face of the rate shock which would unavoidably result from such a policy. On the one hand, the government was indicating to investors its intention to fully deregulate wholesale electricity prices but on the other hand, some senior officials within the government were publicly expressing concern about the risking retail electricity prices following the privatisation process. This uncertainty and lack of credibility no doubt created a high degree of anxiety amongst investors interested in bidding for the federal generation companies.

The cheapness of the "old energy" also complicated the market for new investments. Given the structural peculiarities of the Brazilian electricity infrastructure, it needed an extremely large amount of "peaking" power supplies. As I had explained earlier, the available power supplies are not as much a function of installed capacity as they are of the previsions of rainfall. Since a much lower level of installed capacity is capable of addressing the country's power needs most of time, Brazil's primary investment requirements were, in fact, peaking supplies required for periods of unfavourable hydrological conditions. With few periods of time in which such plants would actually be dispatched, with the prices for old energy being so low, and with the absence of capacity payments, the competitive market was not the right vehicle for ensuring that such plant—essential for long-term security of supply—would actually be built.

6.4. Partial Deregulation and Administrative and Regulatory Errors

For most practitioners in developing countries, the degrees of inefficiencies and corruption are generally so high in public monopolies that switching from a government monopoly to a private monopoly is in itself reform enough. Industrialised country practitioners and theoreticians are more circumspect about the privatisation payoff and have usually insisted on deregulation and competition as the more critical elements in promoting efficiencies, goading innovation and providing benefits to consumers. This policy strategy to combine privatisation with liberalisation has, in turn, been adopted by developing country policymakers, who for most parts have tended to imitate the specific reform models adopted in industrialised countries. The British power reforms, for example, have been both widely recommended and widely copied.

In Brazil, the liberalisation of the electricity market was not the initial policy priority of the electricity reforms. Driving the reforms was the government's desire to ramp up investment in power generation infrastructure and privatisation was their favoured strategy. Years of distorted pricing policies, motivated by Brazil's macroeconomic problems, had left the state-owned electric power firms financially weak and unable to expand the infrastructure. Brazilian policymakers expected that removing unreasonable price controls and privatising the industry would bring in the investment and the efficiencies required to recuperate the supply situation. When devising their power sector reform strategy, however, they borrowed much from the British experience and expanded the scope of the reforms exercise by intending to introduce competition in both wholesale and retail markets.

Liberalisation proved to be a difficult process for Brazilian policymakers from both the technical and the institutional perspectives. Technically, as the preceding sections have analysed, the general complexities of electric power markets were accentuated in the Brazilian case. Because of the need to optimise hydropower resources, spot market prices were defined by computational models and not by the actions of the market participants. Further complicating the

market was the large price differential between the "old energy" and "new energy". Regardless of how the "old energy" issue would be dealt with, the marginal costs of the old plants would remain significantly lower than that of any new plants that would be constructed. Most new plants in Brazil would therefore be of the peaking variety, which are precisely the types of plants for which competitive electricity markets are particularly unsuited.

Since relatively free electricity markets would be unable to deal with the technical challenges posed by the Brazilian electric power infrastructure, various administrative interventions were required. Administrative determination of these issues, however, created the classic problem that markets are inherently most suitable for dealing with—diversity of opinions. Whereas in a market there is a diversity of opinion that serves to make decisions more robust, with the administrative and regulatory approaches, such diversity of opinion and the consequent robustness of decision-making is lost. Furthermore, administrative mistakes are harder to catch because there is no automatic "punishing" response as there is in markets. In Brazil, several such mistakes were made, partly because explicit policy decisions about how to deal with the trade-off amongst competing policy objectives were not made explicit. The following paragraphs relate a sample of the administrative decisions that had to be made and the inadvertent mistakes.

First, the cost of deficit or the VOLL, which ANEEL had established at R$ 684 per MWh, was found to be inadequate. The fall in the value of the Real after the exchange rate crisis in 1999 meant that this value became sub-optimal. Furthermore, this cost of deficit was implicitly assumed to be linear, which is to say that a rationing of 1% or 50% of demand was assumed to result in the same amount of losses to the general economy. In reality the cost of deficit increases with the magnitude of the electricity shortfall. By limiting the expression of the scarcity value of electricity, these price caps reduced incentives for investment.

Second, the dispatch and pricing system used in Brazil meant that many decisions that normally would have been taken by market participants via demand and supply offers had to be decided administratively. Prices in the wholesale market, for example, were determined by the ONS through computation models. To calculate the prices, ONS required data on demand and supply scenarios. Demand was estimated based on data obtained from distribution companies and previsions of economic growth. Supply was estimated based on data provided by ANEEL. ANEEL's calculations about available generation capacity were based on the capacity of power plants whose construction the agency had authorised, but of course there was no guarantee that they would actually be constructed on schedule. As it transpired, many of the plants did get delayed and some others were abandoned. Although the estimates of demand were substantially accurate, supply previsions turned out to be off the mark.

This overestimation of supply contributed to ONS' decision to delay the dispatch of thermal power plants in favour of the cheaper hydroelectric plants. This mistake did not really have a major impact on investment but it did affect the management of the existing energy supplies. Had thermal power been dispatched earlier, the rationing might have been delayed and reduced in scope.

The subsequent power rationing then affected the commercial relations in the industry and further called into question the functioning of the market. After the rationing generators were exposed to liability claims for their failure to supply power. The generators, in turn, claimed that the ONS had socialised benefit by dispatching hydropower at reduced prices even though it would have been prudent to dispatch the more expensive thermal power. Having already

socialised the benefits, the generators claimed, ONS could not now privatise the subsequent losses by holding the generators responsible for the power shortages.

The administrative solutions to the technical problems of the market were hampered by institutional constraints. The centrepiece of the Brazilian electricity reforms—privatisation—was run by the National Development Bank (BNDES) which had the economic skills to chart the privatisation process but not the deep technical knowledge of the electricity industry that was required to guide the liberalisation process. Nominally, the electricity industry came under the purview of the Ministry of Mines and Energy but it maintained only a skeleton staff of electricity experts because, historically, it was Eletrobras that made the technical decisions regarding planning and operation of the system. As Eletrobras was to become one of several competing electric power firms after the reforms it could no longer remain with the responsibilities for planning and operating the electricity system. For this, two new agencies were created: the National Electricity Regulatory Agency (ANEEL) and the National Systems Operator (ONS).

Both agencies suffered initially from inexperience, both technical and political. There were pressures, implicit if not explicit, from other parts of the government to present a more optimistic outlook for the electricity industry and to keep prices low. These pressures originated in the privatisation process which had led to sustained increases in retail electricity tariffs. Average retail tariffs rose almost 50% between 1995 and 1998 and some members of the government began to press ANEEL to control the increase in electricity prices. Such pressures began to skew agency decisions towards politically desirable rather than technically feasible results. ANEEL, for example, came under pressure to not automatically allow the rate increases that distribution companies were entitled to under their concessions contracts, thereby undermining the investment environment.

The institutional uncertainties affected investor confidence and delayed investment in generation. In substance, the government gambled with the security of supply. Given the technical characteristics of the Brazilian electric power system the most expedient way to avoid raising prices was to reduce the security of supply of the system. If there is a certain average electricity price based on a 5% risk of rationing, allowing the risk of rationing to increase allows the nominal value of the electricity prices to remain constant even though the real price increases because the same price now buys less stand-by capacity.

Consultants and analysts who have studied the Brazilian electric power reforms have put forward various ideas for making electricity markets works. These ideas include raising the cost of the deficit and allowing complete pass-through of fuel costs and exchange rate shifts. While such policy actions would allow markets to work, they would not solve the underlying political problem of the reforms: how to minimise the trade-off between prices and security of supply. They would allow an equilibrium to be established between supply and demand markets but would do so by moving the supply curve more upwards than outwards. For example, raising the cost of the deficit and instituting capacity payments, as one consultant recommended, to the levels practised in the UK fundamentally meant increasing the average electricity rates. This would undoubtedly increase investment but allowing prices to rise just so an equilibrium could be reached in electricity markets did not appear to be good policy and the whole point of the government policy was not to allow prices to rise to such an extent.

As it transpired, to resolve this conundrum the government adopted the only possible solution which was available and that was to intervene directly with its own capital to reduce

both the cost and the amount of capital required of the private sector. Indeed, only a very small share of the investment in thermal power was constructed on entirely commercial principles and only three projects—by AES, El Paso, and Enron—were financed purely by the private sector. Most of the projects had a high percentage of public capital and multilateral agency financing. The market mischievously ended up forcing government to assume an even more of an active role in investment.

7. Conclusions

Several lessons can be gleaned from the international and Brazilian experiences with power sector reforms. The most important lesson is that power markets are far more complex than their advocates (and the critics of failed reforms programmes) have allowed for. The complexity of electricity markets, related to their technical characteristics, has created a number of specific performance problems. First, electricity markets do not work very well under conditions of tight supply. When supplies are constrained, problems with price volatility and exercise of market power by some participants have been recurring problems. The combination of tight supplies and demand inelasticity means that prices can rise to very high levels. Second, competitive electricity markets often do not send the right signals for investment in generation, especially of peaking supplies. This, in turn, also feeds into price volatility and exercise of market power because it makes the supply situation even tighter. Third, introducing competition into generation markets has proved feasible but doing the same in retail markets has been much slower. Consequently, deregulation of the industry has been piecemeal and slow and regulatory intervention has further distorted market signals. Fourth, experiments with competitive electricity markets have forced a recognition of the fact that the choice of market design implies making choices about trade-offs amongst various competing policy objectives.

The most important trade-off is between security of supply and electricity rates. Other trade-offs include that of rates versus privatisation receipts and of promoting competition versus promoting large internationally competitive firms. Markets are therefore distinguished by their structure and rules as these structures and rules are implemented to obtain certain desired objectives. While everybody instinctively knows what "market" means, this paper has highlighted the fact that there is not just one model of market in the electric power industry that one can evaluate and pronounce upon. To come back to the minister's phrase "as much market as possible" implies asking market for what and consequently, what type of market. Depending on the policy priorities, the rules of the game, i.e., the market can be very different. Some conceptions of markets become more popular and hegemonic and desirable from a certain point of view and therefore have more legitimacy, but they are not necessarily the most appropriate for some of the contexts in which they have been applied.

Because of these complexities, market-based reforms are not recipes that can be easily transplanted from one context to another. The first part of this paper introduced the reader to the electricity reforms in industrialised countries. Its purpose was to provide a base from which to analyse probable impacts of making electricity markets in developing countries where there is much less of an experience. Even in developed counties electric power markets are works in progress that have taken years or even a decade (or more) to work reasonably well. Often, expensive mistakes have been made along the way as policymakers have groped for the right combination of governance structures to promote competition, efficiency, reliability and economy. Many of these mistakes may not have been extensively publicised because the

wealthier countries have had the financial resources to deal with tricky transition periods, but in other cases, such as in California, these problems have been comprehensively analysed.

The second part of this paper, using the Brazilian experience as a case, has shown that electricity market models developed in industrialised countries and imported into developing countries are prone to malfunctions. Not only are the investment needs of developing countries much greater, they are also more sensitive to changes in price. Developing country reforms also take place in contexts of overall reform and investor scepticism. Further complicating the reforms process is the fact that they are generally initiated when the supply situation is already stressed. This means that developing countries suffer precisely those conditions under which electricity markets do not work well. Given these differences in initial conditions, lessons and recommendations that emerge from industrialised country experiences do not easily translate into developing country situations. Thus, global experiences with electricity market indicate that developing country policymakers would be wise to be more circumspect about how much market is possible in developing countries. There are genuine difficulties in making the right trade-offs and, more importantly, creating the best governance structures to mediate these trade-offs.

The potential efficiency gains from well functioning electricity markets are too valuable to not be pursued. These benefits, however, will come only in the longer term as they are dependent on the introduction of new technologies and services and on the gradual maturation of markets. In the short term, on the other hand, the reality is that volatility, market power and changing prices for consumers will create pressure for policymakers to be more cautious in allowing markets free rein. The policymakers' concerns about insulating consumers from the volatility of wholesale prices, in fact, make the effective functioning of electricity markets even harder. In this, timing is key and attempts to do a number of big changes simultaneously may well stress the governance capacities of developing countries, allowing markets to act mischievously.

The reader looking for an unequivocal judgement between markets and governments, and between competition and regulation will be disappointed. Despite its criticism of the way electricity markets have worked, the paper does not conclude that markets are bad or even that they are incompatible with developing country needs. Rather, it argues for a broader conceptualisation of the state-market dichotomy and a greater degree of realism with regards to the rosy assessment of market potential. Keeping in mind the importance of the role of government in making appropriate market designs more comprehensive planning is required to make the transition to competitive electricity markets. As Hogan (2002) stated, "Electricity is an example where introducing competition leads not to less regulation but different regulation. The details cannot be deferred or left alone to be discovered through the magic of markets." Returning to the second part of the minister's statement, "as little government as necessary" thus appears to be a lot more than previously thought.

References:

Barton, B. 1999. "Risk and Promise in Energy Market Liberalisation: Consumer Choice in Buying Electricity," *Applied Energy* 64.

Borenstein, S., J. Bushnell and F. Wolak. 2002. "Measuring Market Power in California's Restructured Wholesale Electricity Market," *University of California Working Paper.*

Branston, J. 2000. "A Counterfactual Price Analysis of British Electricity Privatisation," *Utilities Policy,* 9.

Brown, A. 2002. "The Privatisation of Brazil's Electricity Industry: Sector Reform or Restatement of the Government's Balance Sheet." unpublished manuscript.

Ministrerio de Minas e Energia. 2002. Comite de Revitalizacao do Modelo do Setor Eletrico, Relatorio de Progresso No. 2. Brasilia, Brazil.

Gall, N. 2002. "Apagao na Politica Energetica," *Braudel Papers #32.* Sao Paulo: Ferdinand Braudel Institute.

Green, R. 1999. "Draining the Pool: The Reform of Electricity Trading in England and Wales," *Energy Policy,* 27.

Greiner, P. 2002. "Solucoes ao Inves de mais Confusao," *Braudel Papers #32.* Sao Paulo: Ferdinand Braudel Institute.

Gunn, C. and B. Sharp. 1999. "Electricity Distribution as an Unsustainable Natural Monopoly: A Potential Outcome of New Zealand's Regulation," *Energy Economics* 21.

Hogan, W. 2002. "Electricity Market Restructuring: Reform of Reforms," *Journal of Regulatory Economics,* 21 (1).

Joskow, P and R. Schmalensee. 1983. *Markets for Power: An Analysis of Electric Utility Deregulation.* MIT Press.

Joskow, P. 1997. Restructuring, Competition and Regulatory Reform in the US Electricity Sector," *The Journal of Economic Perspectives* 11 (3).

Joskow, P. 2001. "California's Electricity Crisis," *NBER Working Paper #8842.*

Joskow, P. and E. Kahn. 2001. "A Quantitative Analysis of Pricing Behaviour in California's Electricity Industry During Summer 2000," *NBER Working Paper #8157.*

Kydland, F and E. Prescott. 1977. "Rules rather than Discretion," *Journal of Political Economy.*

Lowery, C. 1996. "The Pool and Forward Contracts in the UK Electricity Supply Industry," *Energy Policy,* 25 (4).

Midttun, A. and S. Thomas. 1997. "Theoretical Ambiguity and the Weight of Historical Heritage: A Comparative Study of British and Norwegian Electricity Liberalisation," *Energy Policy* 26 (3).

Moore, C. 1975. "Has Electricity Regulation Resulted in Higher Prices? An Econometric Evaluation utilising Calibrated Regulatory Input Variable," *Economic Enquiry* 7.

Newbury, D. 1998. "The Regulator's Review of the English Electricity Pool," *Utilities Policy.*

Outhred, H. 1998. "A Review of Electricity Industry Restructuring in Australia," *Electric Power Systems Research,* 44.

Stalon, C. 1997. "Electricity Industry Governance: Reconciling Competitive Power Markets and the Physics of Complex Transmission Interconnection," *Resource and Energy Economics,* 19.

Stigler, G. and C. Friedland. 1962. "What can Regulators Regulate? The Case of Electricity," *The Journal of Law and Economics,* 5.

Stigler, G. 1952. "The Case against Big Business," *Fortune* 57.

Teisberg, E. 1993. "Capital Investment Strategies under Uncertain Regulation," *The Rand Journal of Economics* 24 (4).

White, M. 1996. "Power Struggles: Explaining Deregulatory Reforms in Electricity Markets," *Brookings Papers on Economic Activities (Macroeconomics).*

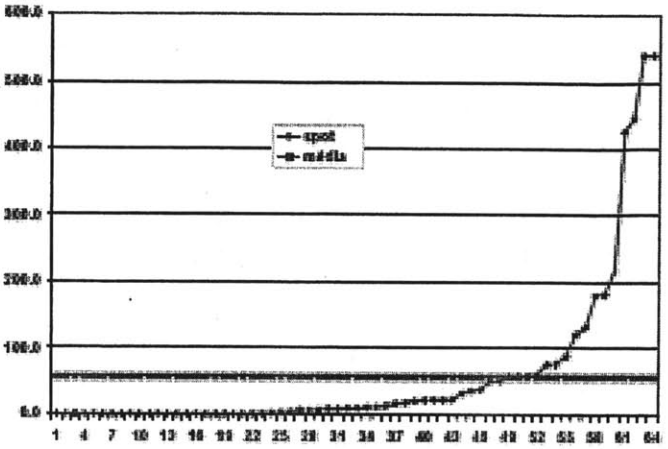
Wolak, F. and R. Patrick. 2001. "The Impact of Market Rules and Market Structure on the Price Determiniation Process in England and Wales Electricity Market," *NBER Working Paper #8248.*

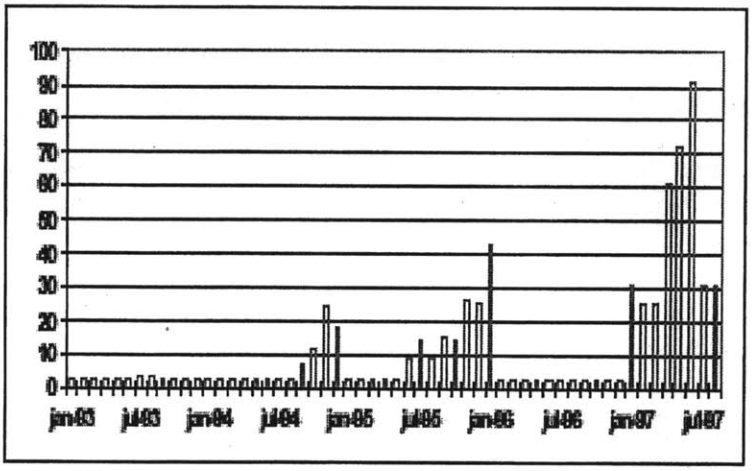
Wolfram, C. 1999. "Measuring *Duopoly* Power in the British Electricity Spot Market," *American Economic Review* 89 (4).

Woo, C. 2001. "What went wrong in California's Electricity Market?" *Energy* 26.

Yarrow, G. 1992. "British Electricity Prices since Privatisation," Research Report, Regulatory Policy Research Centre, Hertford College, Oxford, England.

Figure 1: An Illustration of the Low Levels of Prices Prevalent in Brazilian Spot Markets





2484-81