Available online at www.sciencedirect.com
ScienceDirect
Energy Economics 30 (2008) 1536–1567
Energy Economics
www.elsevier.com/locate/eneco

Electricity reform in Argentina: Lessons for developing countries ☆

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Received 26 February 2005; received in revised form 19 October 2007; accepted 27 December 2007
Available online 11 January 2008

Abstract

Argentina was one of the first countries in the world to implement a comprehensive reform of its electricity sector. Among developing countries only Chile has had a comparably comprehensive and successful reform. This paper traces the history of the Argentine reform, which began in 1992, and assesses its progress and its lessons. We conclude that the reform was very successful prior to the collapse of the Argentine peso in early 2002. We suggest lessons for the generation, transmission and distribution (and retailing) sectors, as well as the economic regulation of electricity and the general institutional environment. We note that the achievements of the sector have been severely strained by the government's poor energy policy since the crisis.

JEL classification: L33; L51; L98

Keywords: Argentina; Electricity; Restructuring; Regulation; Privatisation

1. Background

Argentina is one of the world's leading countries in terms of comprehensive electricity sector reform. The sector was substantially restructured in 1992 as part of the reorganisation and privatisation programme of the first term of the government of President Menem. The system

☆ This paper was originally prepared as part of the research program on Industrial Organization Policy for Development at the Development Research Group of the World Bank. The author acknowledges the wonderful support of Ioannis Kessides, the provision of data by the ENRE and discussions with stakeholders in the industry as part of the original research for this paper. He also acknowledges helpful comments from Liz Hooper, Stephen Littlechild, David Newbery, Martin Rodriguez-Pardina, Jon Stern and an anonymous referee on earlier drafts of the paper and the ongoing financial support of the ESRC Electricity Policy Research Group. The findings, interpretations, and conclusions expressed in this paper are entirely those of the author and do not necessarily represent the views of the World Bank, its Executive Directors, or the countries they represent.
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doi:10.1016/j.eneco.2007.12.012

performed impressively until the macroeconomic crisis of 2002. Since then interference in the running of the system has threatened to obscure the initial periods acheivements (and learning) while providing its own lessons in how not to manage energy policy.

This paper serves three purposes: to document the successes of the 1992–2002 period; to discuss some of the problems that arose during this period; and finally to highlight the mistakes of the post-crisis period. This is because Argentina is an important case study for other developing countries.[1]

In the rest of this section we lay out some of the macroeconomic background to the sector. Section 2 discusses the history of the electricity privatisation and liberalisation process prior to the 2002 macro-economic crisis. Section 3 provides some detail on the performance of the sector during this period. Section 4 introduces detailed lessons from the experience in the generation, transmission, distribution and retailing segments of the sector, as well as lessons for the practice of regulation and the general institutional framework, focussing on the pre-crisis era. Section 5 details some of the post-macroeconomic crisis developments in the sector. Section 6 concludes with the clear messages for other developing countries.

The recent fluctuations in the experience of the electricity sector in Argentina cannot be separated from that of the rest of the economy. Argentina has had a turbulent economic and political history. In 1913 Argentina had a higher per capita income than France, Germany and the Netherlands.[2] Its wealth was based on its large and fertile agricultural land area capable of producing high value added exports, in particular beef cattle. However the country struggled to convert its initial advantages into successful industrial development and was troubled by a substantial underclass and associated poor distribution of income. The election of a populist government led by General Peron in 1946 was followed by a military government in 1955, which continued with only brief interludes of democracy until 1983. This sorry history was marked by class conflict between rich landowners, the middle classes and the underclass. By 1983 Argentina had been reduced to a developing country with large international debts and high unemployment.

Following a sharp deterioration in the country's fortunes during the 1980s, Carlos Menem was elected president in 1989. Menem was a populist from the Peronist party and initially espoused an agenda of radical social reform. However realising that Argentina's hyperinflation was driven by large fiscal deficits, the Menem government began a massive privatisation programme which eventually privatised 154 state companies in energy (including gas supply and electricity) telecommunications, railways, banking and other sectors.[3] The privatisations raised $19.4 bn, including $14 bn of cash and $13.7 bn of nominal debt repurchased — this sum represents around 13% of GDP in 2002. 80% of the revenue was raised between 1990 and 1993. The privatisations also substantially reduced the losses of state owned companies, which had been 3% of GDP in 1989.[4] The scale and speed of the privatisation was staggering. Even in the UK, thought to be the world leader in mass privatisations, the total sum raised was only around 10% of 2002 GDP and it took around 12 years to raise 80% of the total value.[5]

The privatisation of the electricity sector was one of the most significant privatisations and was masterminded by the Minister of Energy, Carlos Bastos.[6] Bastos was one of the leading reformers

[1] We limit ourselves to lessons for developing countries. Arguably, Littlechild and Ponzano (2008-this issue) demonstrate the case for more use of negotiated regulation in *developed* countries given the potential exhibited in the developing country context of Argentina.

[2] See della Paolera and Tayor (2003) for a collection of essays on the economic history of Argentina.

[3] See Galiani et al. (2003), Section 2, for details of the privatisation programme.

[4] See Ennis and Pinto (2002 p.71).

[5] See Pollitt (1999, p.37).

[6] See Bastos and Abdala (1995).

within the government. The privatisation programme occurred against the important macro-economic background of the creation of one to one convertibility between the Argentine Peso and the US dollar in 1991. This provided assurance for foreign investors who enthusiastically bought shares in the newly privatised companies and began to invest heavily in upgrading the capital stock of their companies.

The privatisation programme successfully reduced the government debt in the early 1990s and associated interest payments.[7] Government debt fell from $78.9 bn in 1990 to $69.6 bn in 1993 and associated interest payments as a percentage of GDP stayed low in the first years of the 1990s before rising sharply as the privatisation revenue stream slowed. Public finance for commercial activity fell from 11.7% of public expenditure in 1991 to 5.4% in 2000, of this fall more than half was due to reduced support for the electricity and gas sectors.[8] The stock market was significantly increased in size with 38.5% of all dividends paid between 1992–1999 coming from privatised companies. However in the second Menem term government expenditure began to increase rapidly and the fiscal deficit began to worsen. This put pressure on the parity between the dollar and the peso. Menem's term of office ended in 1999.

The macro-economy continued to deteriorate and in early 2002 the government was forced to abandon peso parity with the dollar and let the currency float freely. The Peso collapsed to less than 30% of its former value and Argentina defaulted on its overseas debts. This economic crisis, which was accompanied by bank runs and a massive surge in unemployment, provoked a political crisis. The elected President Fernando de la Rua was forced to resign in December 2001 to eventually be replaced by the interim administration of Eduardo Duhalde in January 2002. His administration lasted until fresh elections in May 2003 when Nestor Kirchner succeeded to the presidency (in December 2007, Kirchner's wife Cristina became President). The economy began a recovery as its exports benefited from the effect of the massive devaluation. Between the trough of the crisis in the first quarter of 2002 (at which point almost all of the growth between 1993 and 1998 had been reversed) and the first quarter of 2007 the GDP has grown by more than 7.5% per annum.[9] This recovery has come at the price of defaulting on its sovereign debt, a loss of international investor confidence and is unlikely to prove sustainable. In the aftermath of the crisis Argentina was rated as one of the worst prospects for electricity investment of any large developing country.[10]

The period since the crisis of early 2002 has had a marked effect on the privatised sectors. Most privatised companies were under foreign ownership at the start of the crisis and had prices that were officially pegged to the US dollar. This was the contractual underpinning of the large investments which overseas companies have made in Argentina since 1990. In the electricity sector total investment was $12.5 bn, of which 60% was represented by post-privatisation investments (much of it coming from overseas investors).[11] Regulated residential tariffs were frozen in peso terms in February 2002 leaving most companies shouldering heavy financial losses given that loan financing for investments had been arranged in dollars. The World Bank has been involved in protracted negotiations with the government about allowing the prices to rise in order to allow some recovery of initial investments and to ensure that future investment is not prejudiced. Some progress has been made recently towards settling the financial claims of the companies and allowing higher prices in return for some new investment, but investment remains

[7] See Ennis and Pinto (2002, pp.71-79).
[8] See Ennis and Pinto (2002, p.78).
[9] Source: www.indec.gov.ar. The GDP index, taking Q1 1993 as 100, peaks at 128 in Q2 1998, troughs at 102 in Q1 2002 before reaching 151 in Q1 2007.
[10] Survey reported in Lamech and Saeed (2003).
[11] CAISE (2002, p.4).

limited and prices below economic cost. The government has consistently imposed price limits on the companies which have kept prices artificially low, in particular for the residential sector, in order to control inflation. Since the beginning of 2004 strong demand for electricity stimulated by rapid economic growth and low relative energy prices, has led to electricity supply shortages and emergency measures to reduce demand and increase domestic supply. In both January and June 2007 (summer and winter peaks) there have been severe supply problems.

As della Paolera and Taylor observe 'the economic history of Argentina since the late nineteenth century ..[is].. one of the most puzzling stories in the annuals of modern economic history' (p.1). In spite of a well-educated workforce, abundant natural resources and strong cultural links to both Europe and the US it is characterised by political instability and periodic macroeconomic crises of a substantial magnitude. The political system finds it very difficult to manage the state budget responsibly and to stabilise the macro environment. Within this context, making credible commitments not to arbitrarily regulate the electricity sector and to honour concession contracts is very difficult. The instability of the Argentine institutional environment since 1973, when President Peron (elected for a third time) died in office, is in marked contrast to its neighbour Chile.[12]

Argentina is an important case study of electricity reform because it shares many of the features of developing countries' electricity systems. Like Brazil and India it is a federal state and the provinces retain a large degree of autonomy over the regulation of local utilities including the power to privatise local distribution utilities and to set residential prices. Size is not a barrier to a successful electricity reform in Argentina: the population is 38.4 m (larger than each of Australia, Chile, Norway, New Zealand and Sweden who have had some success with electricity reform). The GDP per head was US $2700 in 2002 (at market exchange rates), this figure being barely unchanged from that in 1992 following a 15% fall in GDP between 2000 and 2002.[13] Electricity consumption per head is relatively low but grew rapidly between 1992 and 2002 (3.3% p.a.). The electricity system has significant hydro capacity (just under 40% of the total in 2002)[14]. Following the crisis GDP and electricity demand have recovered, with growth of electricity demand at 7.5%p.a. between December 2001 and December 2006.[15] Argentina shares the political and macroeconomic instability of many other developing countries but is unusual because few other developing countries have demonstrated its capacity for designing and running the sophisticated economic institutions which emerged during the 1992–2001 period in its deregulated electricity market.

2. Argentina's electricity reform

The privatisation of the electricity sector was one of the most comprehensive of the Menem period. Starting from an industry which was wholly state and provincially owned, more than 80% of the generation, all of the transmission and 60% of the distribution sector was transferred into private ownership. Remaining public ownership was limited to the state owned nuclear power generating company and two hydro-electric plants (with part foreign ownership) in the generation sector and some provincially owned distribution companies. There was also significant co-operative ownership[16]. The comprehensive nature of the electricity reform in Argentina reflected

[12] See Murillo (2001) and Heller and McCubbins (1996) for comparisons of the political background to reform in Chile and Argentina.

[13] Source: World Bank, 'Argentina at a glance', at http://www.worldbank.org/data/countrydata/aag/arg_aag.pdf.

[14] Source: CAMMESA website.

[15] Source: CAMMESA website.

[16] 593 cooperatives, represented by ADERRA members, distributed around 10% of the total electrical energy in 2006 (www.aderra.com.ar).

the neo-liberal nature of the incoming government and the poor performance of the sector prior to privatisation. Severe blackouts had occurred in the summers of 1988 and 1989, thermal generation plant suffered from poor availability (over 50% unavailable in 1991) and distribution system losses (up to 22% in 1991) were high (partly due to theft).[17]

Half of the population live in the Greater Buenos Aires area (the so called Gran Buenos Aires). This area accounts for nearly half of GDP and of electricity demand. The national transmission system is focussed on supplying power to this region. The state owned companies in this region were at the forefront of the privatisation. A first attempt to address the problems of the sector was the adoption of the Federal Electricity Pact (Pacto Federal Electrico) in November 1989, but by early 1991 nothing much had changed. A new electricity industry was designed in 1990–91 by the Ministry of Energy, with technical assistance from the World Bank. It came into being with a new Electricity Law (24,065) in April 1992 and was carried out over 1992–93.[18] This law together with Decree 634/91 of April 1991 constituted the legal framework for the transformation of the sector and provided for: the break-up and sale of the existing state owned companies; the creation of a wholesale energy market; the creation of a sector specific regulator; and the definition of the powers of the Secretary of Energy in the new system. At the same time a Federal Energy Council was established to advise the Secretary of Energy and the Congress and administer the National Fund of Electricity, which is used for regional subsidies, though this was not integral to the reform.

Law 24,605 characterized electricity transmission and distribution as public services to be provided under monopolistic conditions and thus prescribed regulatory oversight of prices and quality to guard against the abuse of market power and monopolistic exploitation. The law further required "open access" for transmission and distribution facilities — third parties are to be afforded non-discriminatory access to the grid. Distributors were placed under a public utility obligation to supply all the energy demanded within their concession areas. Generation on the other hand was deemed to be a structurally competitive activity. Still the law required generators at each delivery site to receive a rate (taking into account the system's short-marginal cost and the cost of non-supplied energy) set by the National Load Dispatch (Legisa, 1999).

The largest state owned company Servicios Electricos del Gran Buenos Aires (SEGBA) was broken into 5 generation firms and 3 distribution companies.[19] The distribution companies created were Edenor S.A., Edesur S.A. and Edelap S.A. The first two were the largest and represented more than 1/3 of all electricity customers in the country and their privatisation in September 1992 raised 1/3 of the total privatisation proceeds from the sector. The second largest firm Agua y Energia Electrica (AyE) operated 16 generation plants, transmission lines and provincial distribution companies. Its privatisation began in early 1993 as its power stations were separated and sold off. Hidronor, which operated hydro power plants in the Comahue region was privatised in mid 1993. This was accompanied by the granting of concessions to operate one national transmission grid (Transener) and five regional grids. In 2001 there were more than 40 generation companies operating in Argentina and more than 30 distribution utilities (with concession areas) and most were privately owned and operated.

The Argentine electricity privatisations raised $3.1 bn for the central government and associated privatisations by the provinces raised a further $2.1 bn. The privatisation drew heavily on the experience of privatisation in Chile and the UK, then seen as the pioneers of electricity reform of state owned electricity companies in the post-World War II period. Thus the design of the market for

[17] See CAISE (2002, pp.19–20).
[18] See Delfino and Casarin (2003) for details of the break-up of the state owned electricity companies.
[19] See Delfino and Casarin (2003).

wholesale power was based on the Chilean market which had a cost based bidding system for scheduling power plants and an independent system operator (ISO) responsible for dispatch. There were also echoes of the Chilean system of seasonal average prices being passed through to regulated customers. The large scale break up of the generation sector and the separation of generation, transmission and distribution reflected the UK experience from 1990. The UK had separated transmission and generation and continued the separation between distribution and generation. It was also experiencing problems of having an overly concentrated generation market which the Argentine system was at pains to avoid. The Argentine model of regulation with the creation of an independent national electricity regulator, ENRE, drew on the UK model by vesting responsibility for setting regulated tariffs in a specialist independent agency with responsibility only for the electricity sector.

The break up of the ownership of the generation sector was accompanied by the creation of a Wholesale Electricity Market (MEM). This market covered most of the country (and 93% of electricity demand) apart from the far south, which had its own non-interconnected market (MEMSP) until December 2005 with the systems were connected. The MEMSP supplied 6% of total electricity demand with the remaining 1% of power demand supplied by small isolated systems. The MEM is managed by a corporation: CAMMESA.[20] Its functions are to carry out efficient dispatch (via the Dispatch Management Agency — Organismo Encargado del Dispatcho), co-ordinate centralised operation and the manage the MEM generally. CAMMESA is a not-for profit joint stock company owned by the Association of power generators (AGEERA), the Association of large users (AGUERRA), the distributors' association (ADERRA), the association of high voltage transmission companies (ATERRA) and the Secretariat of Energy (the responsible government ministry). Each shareholder has 20% of the company. CAMMESA has a board of 10 members to which each association appoints 2 members. The Secretary of Energy (the chief minister of the Secretariat of Energy) is another member and the final member is appointed with the assent of three of the associations subject to the veto of the Secretary of Energy. Its decisions are made by majority voting but must include the Secretary of Energy. In the event of a tie the Secretary of Energy's vote counts as double and in the event of a disagreement the Secretary of Energy decides.

The actual power market, which CAMMESA manages, involves a cost based energy price determination system.[21] Every 6 months (July and December) thermal and nuclear generators submit bids for the price at which they are willing to supply energy in every hour for the next six month period (November to April and May to October). Bids cannot exceed 115% of the actual fuel costs incurred by generators in their fuel purchases. They can be adjusted within the six month pricing period if fuel prices fluctuate by more than a certain percentage. All generating plants are also required to declare availability. Hydro generators must declare the value of water in their reservoirs. Using demand forecasts for each day CAMMESA determines the marginal plant for each hour of operation during a given day (there is no demand side bidding as such). Local prices can develop where there are transmission constraints. Generators receive the spot price plus a nodal factor and a capacity charge if they are running during the period 6am to 11pm[22]. This fee was fixed at $10 USD per MWh in 1994 and is added to the energy cost of the marginal turbine on the system[23]. Optimal dispatch also takes account of start up costs in the system. Fuel costs are

[20] See Rodriguez-Pardina (2004) for details of the governance of CAMMESA.

[21] See Ferreira (2002) for details of the operation of the wholesale power market.

[22] The "Market" node is located at the System Load Centre (the Ezeiza 500 kV node in the Greater Buenos Aires/Litoral Area). In each of the other nodes on the grid the energy price takes into account the cost of taking the energy to or from the Market node.

[23] This capacity charge was calculated as the sum of a base price ($5 USD/MWh) and a reliability price determined by the Secretariat of Energy (in May 1994 it was set at $5 USD/MWh).

subject to verification by CAMMESA, for gas plants the reference price is that provided by the national gas company, ENERGAS, for oil the reference price is the New York price and coal prices only affect one plant. There were initially four emergency tariffs ($120, $170, $240 and $1500 per MWh) which can be set at times of shortage.

In 1991 generation was initially in the hands of four major companies with a combined market share of 77.3% with the largest company (SEGBA) having a market share of 23.3%.[24] By 2002 SEGBA and other state-owned companies had been separated into many successor generating companies, so there were more companies in the market and the share of the largest four largest private companies was 40.5%, with the largest private firm having a market share of 12.3%. The energy market was liberalised for customers with demands greater than 5 MW, this has been successively reduced to 30 KW. These customers are free to contract directly with generators and can participate directly in the generation market. As a result of this liberalisation the number of participants in the MEM was 2527 in December 2002 that included 38 generating companies and 2308 large energy users. At this time national installed capacity was equal to 23.6 GW. The liberalised market accounts for around 50% of national electricity demand.

Electricity transmission charges are paid by generators and suppliers and there is non-discriminatory right of access to all transmission lines.[25] For existing lines these are based on regulated tariffs (regulated third party access). Transmission lines are operated under 95 year concessions subject to management contracts which are renewed every 15 years. Transmission charges were to be reviewed every 5 years by ENRE. Transener holds the national transmission concession and faced their first five year renewal in 1998, of which more detail later.[26] The basis of the regulation was to be incentive based regulation of the required revenue of the transmission company such that the regulated revenue would be fixed in real US dollars and subject to an annual efficiency adjustment.[27] This approach was borrowed from the UK and indeed Transener was part owned by the UK's National Grid Company from 1993 to early 2004.

However Argentina followed a new approach to large transmission expansions: the so called 'Public Contest' mechanism.[28] Transmission expansion could be determined by an innovative voting arrangement combined with an allocation of costs on the basis of usage. The methodology used to determine the "beneficiaries" of a new transmission line and what are the percentage levels of the benefits of the various beneficiaries was based on energy usage (rather than on economic or market benefits). Once new lines were built payment was to be on the basis of energy usage, those whose power went down the line would have to pay for it, independently of how the line affected their overall financial position. Littlechild and Skerk (2008-this issue-a,b,c,d) provide extensive analysis of Argentina's innovative transmission arrangements.

Transener was not responsible for system planning but only for operation and maintenance of existing lines. Proposals for new lines could be made by at least 30% of affected users and subjected to a vote of all the affected users. At the next stage a vote would be taken on whether to put the line out to tender, if more than 30% of the users affected by the new line voted against the line then it would be not be put out to tender. This procedure was particularly important when

[24] Market data on the MEM and the MEMSP has been supplied by ENRE.
[25] See Vignolo (2000) and Gomez-Ibanez and Rodriguez-Pardina (2001a,b).
[26] For a discussion of the regulation of Transener see Gomez-Ibanez and Rodriguez-Pardina (2001b).
[27] The efficiency adjustment could not exceed 1% per annum or cumulatively 5% throughout the review period.
[28] For discussions of the transmission expansion regime in Argentina see Abdala and Chambouleyron (1999), Gomez-Ibanez and Rodriguez-Pardina (2001c), Gomez-Ibanez and Rodriguez-Pardina (2003) and Littlechild and Skerk (2008-this issue-a,b).

considering major transmission lines linking the hydro and gas plants in the south to the load centre in Buenos Aires. Lines approved under this mechanism would be subject to competitive tendering. CAMMESA also administered a fund, which collected the transmission congestion rents accruing on congested lines (the difference between the prices received by constrained generators and the prices paid by constrained customers). Each fund could be used towards transmission expansions that relieved congestion in the corresponding transmisison corridor.

Electricity distribution in the Greater Buenos Aires area is regulated under concession contracts. These asset concession contracts are for 99 years, with prices originally subject to review every 5 years, at which time the distribution tariffs for regulated customers were to be reset following assessment by ENRE under the principles of incentive regulation. Under the concession contracts electricity distributors were responsible for bill collection and were given strong incentives to reduce energy losses. These were initially very high due to a combination of technical inefficiency and theft. Third party access charges to the distribution network are not regulated and are subject to negotiated third party access. For regulated customers (which include all residential customers, small commercial and small industrial customers) the regulated electricity tariff can be adjusted every three months. The basis of this adjustment was the seasonal energy price, which is set every 6 months.[29]

The seasonal prices are based on estimates of prices calculated by CAMMESA; these can be altered after 3 months by the Secretary of Energy if there are significant differences between the actual prices and estimated prices within the period. The energy price faced by each distribution company is determined according to nodal factors. The capacity price faced by distributors is based on a fixed monthly payment based on the actual power contracted by the distributors during the capacity charging period and the total forecast payments during the 6 month period which the generators are due to receive for capacity. Final prices for regulated customers were a combination of the seasonal energy and capacity charge and transmission and distribution value added charges. Distribution charges could be reset every 5 years at the request of the companies but no request came in 1997 and so the next opportunity for a price review was to be in 2002. No proper regulatory review has yet been conducted following the macroeconomic crisis as prices are the subject of negotiation with the government. Outside Buenos Aires, other provinces have their own system of regulation of distribution but their distributors pay for energy for regulated customers using the same seasonal price formula and most have based the regulation of final tariffs on the principles set out in the 1992 Electricity Law. By 2000 around 25% of provincial electricity distribution was privatised (e.g. in Cordoba and Mendoza).[30]

The regulatory agency, ENRE, was made responsible[31] for: protecting users rights; promoting competition in production and encouragement of long term supply; promotion of open access in transmission and distribution; regulation of transmission and distribution tariffs; promotion of efficiency and encouraging investment. In contrast to the situation in Chile where the activities of the regulatory agencies were sharply prescribed ENRE was tasked with producing a large number of regulations to do with: security and safety and quality standards and the basis for tariffs and the awarding of concessions.[32] ENRE was therefore to be left to develop appropriate methodologies to set the regulated distribution tariffs and the regulated transmission tariffs. In transmission they did this in the 1998 price control for Transener and were working on the methodology of

[29] See Vignolo (2000, pp. 11–12).
[30] See Vignolo (2000, p. 15).
[31] Law 24,065, Article 2, on Electricity Law Objectives for ENRE.
[32] Law 24,065, Article 56, on Functions and Capabilities of ENRE.

assessment for the distribution companies price review. Between 1992 and 2001 ENRE issued no less than 131 resolutions concerning the regulation of the electricity sector.[33] In 2003 ENRE seemed well resourced with 158 staff, of which 87 were professional staff (15 were economists).

The governance of the electricity sector in Argentina established in 1992 maintained a large role for the Secretary of Energy.[34] He heads the board of CAMMESA and he appoints 3 of ENRE's 5 directors. He monitors the two remaining state owned hydroelectric plants (Yacyreta and Salto Grande) and the state owned nuclear power company (Nucleo Electrica). He also sits on the Federal Electricity Power Council (CFEE) which has responsibility for the management of the National Energy Fund. ENRE has responsibility for dispute resolution in the sector but in the event of disputes with ENRE the Secretary of Energy arbitrates. The provinces via the Federal Electricity Power Council appoint ENRE's two remaining directors. The Secretariat of Energy has majority ownership of the National Transmission Dispatch agency (DNDC) for which CAMMESA has the management.

The initial privatisations attracted a large amount of foreign interest with many of the firms passing into foreign ownership soon after the initial offering. An estimated 30 foreign companies had investments in the Argentine electricity sector in 2002.[35] The generation market has seen significant amounts of new entry by foreign utilities and investment by incumbent utilities. AES of US, Endesa of Spain and Total Fina Elf of Europe became major players in the generation sector. Transener was taken over by an consortium led by the British company, National Grid. In distribution Edesur was taken over initially by Enersis of Chile and then Endesa of Spain, Edelap by AES and Edenor by EdF of France. Ultimate parent firms control both distribution and generation companies but usually with less than 100% shares in both companies.

The initial generation market had a low concentration ratio. The market shares of the leading firms have increased since 1992 but the market remains less concentrated than most European and North American markets. The Herfindahl Hirshman Index of concentration (HHI) was 708 in 2002 in terms of energy sold to the wholesale market by business unit (though the HHI was 1589 when cross-share holding is accounted for).[36] In transmission there was a sustained attempt to gain approval for a fourth major transmission line from the Comahue region in the south to Buenos Aires.[37] This line was initially proposed in September 1994 with a capacity of 1000 MW at a cost of about $429 m USD[38]. The beneficiaries would have included seven generators in the Comahue region supplying Greater Buenos Aires who frequently faced transmission constraints. However more than 30% of the pool of beneficiaries voted against the proposal even though there was a consensus among the regulator and politicans that extra transmission capacity was needed. Eventually a negotiated agreement was reached and the competitive bidding led to a much cheaper upgrade than originally envisaged. The new plan was approved in September 1996. The new capacity became available in 1998. The apparent delay caused by the veto system during the fourth line negotiation prompted a radical proposal for a system of transmission capacity rights.[39] This was proposed by the then Secretary of Energy just before the end of the Menem government but was dropped by the new administration.

Two major attempts at revising the 1992 Electricity Act occurred in 1999 (Resolutions 543 and 545 of 1999) and in 2001 (Decree 804 of 2001).[40] These attempts at revision are interesting

[33] See Rodriguez-Pardina (2004).
[34] See Rodriquez-Pardina (2004).
[35] See CAISE (2002, p.8).
[36] Source: ENRE. ENRE also find that the economic group HHI increases from 1446 in 2000 to 1589 in 2002.
[37] See Abdala and Chambouleyron (1999).
[38] See Littlechild and Skerk (2008-this issue-b).
[39] See Gomez-Ibanez and Rodriguez-Pardina (2001c).
[40] See Rodriguez-Pardina (2004).

because they were pro-reform and aimed at strengthening the original reforms. Both of these were subsequently overturned and were not put into place.[41] We will make some reference to their proposals in what follows. The major event affecting the sector has undoubtedly been the macro-economic crisis (and the government reaction to it). Regulated electricity tariffs, as we have seen, were pegged to the US dollar. In February 2002 when the peso was allowed to float freely all prices within the sector were delinked to the US currency and fixed in nominal pesos. This has affected the capacity payment in the power market, which is the one specified price in the market. The fuel prices from which energy prices are calculated have been affected by pesification in the gas market, where the price of gas from ENERGAS has been fixed in pesos. This has limited the impact of pesification on the peso energy price. Regulated transmission and distribution charges were also converted to pesos. The impact of this on the electricity sector, as in most privatised sectors, has been profound. We return to this in Section 5.

3. The performance of the Argentine electricity sector between 1992 and 2002

In this section we report some indicators of performance of the sector over the reform period. The areas which we look at are those that relate most directly to the social welfare (in the social cost benefit analysis sense of Galal et al., 1994) effects of the reform and those indicators that are most important in a developing country context. There are some papers, which attempt to measure the overall welfare effects of the Argentine privatisation program (including electricity). These studies do find significant overall welfare benefits from privatisation.[42]

3.1. Investment

Between the beginning of 1992 and the end of 2002 the installed capacity in the main MEM system expanded from 13,267 MW to 22,831 MW (4.9% p.a.). The capacity of the MEMSP system was only 778 MW at the end of 2002. The reserve margin was 46% at the peak in 2002 (highest demand divided by available capacity). The expansion of generation capacity was achieved by privately owned operators and while keeping prices low. The number of units delivered increased by 45800 GWh to 72106 GWh from 1992 to 2002 (4.6%). The total investment was around $7.5 bn in fixed assets between 1992 and 2002.[43]

In transmission the route length of transmission lines in the main MEM system expanded from 16,958 kM to 22,140 kM (2.7% p.a.) between 1992 and 2002.[44] In distribution the total number of electricity customers was 9.835 m in 2001. Of these the number in the two largest SEGBA successor companies was 4.34 m in 2002, this was an increase of 11% from 1993. This includes the effects an ambitious plan to connect 650,000 shanty town households to the electricity network between 1994 and 1998 via collective meters that achieved its objectives over the period.

By the standards of other developing countries this is a very good investment record.

[41] These were not the only reforms and the first set of reforms in 1999 were suspended in 2000 and subsequently repealed. The 2001 reform decree was repealed before the year was out.

[42] See for example: Delfino and Cesarin (2003), Chisari et al. (1999) and Benitez et al. (2003). The latter two papers also show that effective regulation which transfers benefits to consumers reasonably quickly will significantly raise the consumer benefits from privatisation.

[43] Source: CAISE (2002, p.4).

[44] CAMMESA Annual Report 2002, p.74.

3.2. Prices

By 2002 electricity prices in Argentina were the lowest in Latin America and extremely low by world standards.[45] In May 2002 residential tariffs were just 2.5 US cents per kWh for a residential consumer compared with 9.8 cents a kWh in the US, while industrial tariffs were a mere 1.3 cents per kWh (against 5.9 cents in the US). This reflected the effect of pesification on the sector and price limits. Prior to the crisis the comparable prices were 8.9 cents and 4.8 cents per kWh. These prices reflected the significant amount of hydro in the Argentine generation mix (33% of total capacity) and the efficiency improvements seen in the generation sector since 1992.

Devoto and Cardozo (2001) examine the evolution of tariffs in the Greater Buenos Aires Area compared with those under SEGBA. They demonstrate that the pricing mechanism eliminated the large fluctuations in the real value of tariffs seen in the 1980s. It also led to a fall in the average real tariff from 9.1 cents/kWh in 1992 to 6.4 cents per kWh (29%) in 2001.[46] This fall is almost entirely explained by the fall in the cost of wholesale power in the MEM[47], where as Fig. 1 shows the nominal US dollar price of energy fell 70% pre-crisis. Devoto and Cardoso (2002, p.22) show that industrial customers benefited disproportionately from the falls in the wholesale price pre-crisis. The average captive customer saw their price decline from 9.1 cents to 7.8 cents/kWh (14%) from 1992 to 2001. Though among captive customers the smallest residential (making up around 38% of total customers) customers on Tariff T1-R1 saw their prices rise by 25%. Haselip et al. (2005) note that significant numbers of poor consumers were forced to pay for electricity which they had previously received via free (albeit illegal) connections, representing a welfare loss to this group. This suggests that electricity reform did lower prices but not for the poorest, which might explain some of the political hostility to privatisation, which President Nestor Kirchner's policies reflected.

3.3. Financial performance

The low price of electricity and high rates of investment in the sector prior to 2002 were accompanied by strong financial performance by the companies involved. Financial performance in the SEGBA had been very poor prior to its reorganisation. After privatisation the average post-tax rates of return on shareholders' funds in generation were 4.6% in 2000[48], though they appear to have been higher in previous years. And in transmission Transener's post tax rate of return on equity was 6.8% in 2000.[49] Among the distribution companies rates of return on equity were rather higher: Edenor and Edesur earned post tax rate of returns on equity of 10.9% and 9.5% in 2000[50]. These rates of return are respectable by international standards but look low given the country risk associated with Argentina. In Transener's price control review of 1998 the country risk premium was estimated to be 4.89% p.a. in real terms.[51] It seems clear that investors were not

[45] See CAISE (2002, p.15) for evidence on the impact of crisis on relative tariffs.
[46] Devoto and Cardozo (2001, p.16).
[47] Devoto and Cardozo (2001, p.20).
[48] Net income divided by Net Worth for a sample of four generation companies (Central Puerto, Central Termoelectrica Buenos Aires, Central Costanera and Central Termica Guemes). Data taken from accounts and summary financial statements available at www.cnv.gov.ar.
[49] Net income divided by Shareholders' Equity (see Transener Annual Report 2001, p. 3).
[50] Net income divided by Shareholders' Equity (see Edenor Financial Statement 2003, English Translation, p. 44 and Edesur Annual Report 2003, p. 39).
[51] See Gomez-Ibanez and Rodriguez-Pardina (2001b, p.13).

getting this return in generation before the crisis. One can therefore question whether financial performance was satisfactory in this period and whether investors original investment levels were rational given subsequent returns. However this does seem to be evidence of strong competition in the generation market.

3.4. Efficiency improvements

The falls in prices and moderate rates of return reflect large efficiency improvements in the industry. Employment in SEGBA and its successor companies fell, from 21,535 in 1987/90 to 7,945 in 1997, a fall of 63%.[52] This overall improvement reflects a large decrease in generation plant unavailability from over 50% to around 20% in just 5 years as well as labour efficiency improvements in both generation and distribution.[53]

Labour productivity in generation improved substantially; in Endesa Argentina (the second largest generator in 2002) labour productivity improved from 13 to 35 GWh generated per employee between 1995 and 2000. Fig. 2 shows sales per employee in the two largest distribution companies improved from less than 2 GWh in 1993 per employee to 5.7 GWh per employee in 2001. These numbers compare very favourably with experience in the UK where labour productivity improved by less over a longer period.[54]

3.5. Shanty town electrification

A notable initial success in Argentina has been the regularisation of connections and payment for the large numbers of shanty town dwellers in the Greater Buenos Aires area.[55] Beginning in 1994 the central government embarked on an ambitious plan to put in regular metered electricity connections to shanty town areas. The three incumbent electricity companies were given capital subsidies to connect the poor customers and did so at a very rapid rate. By end of 1998 650,000 new customers had been added under this scheme. The percentage of the poorest income decile households in Greater Buenos Aires area with electricity had risen to 99% in 1996/97 from 65% in 1985/86.[56] This had a positive impact on the social welfare of these households as they often wanted electricity for heating and for pumping water. Non-payment was reduced as payments were regularised and as local governments began to pay for the very poorest customers usually via municipal meters which recorded aggregate consumption for up to 1000 households. This experience was clearly a very positive outcome for privatisation, whereby the principle of paying a market price for electricity to the companies was combined with a well financed programme of subsidised tariffs.

[52] See Ennis and Pinto (2002, p. 50).

[53] Benitez et al. (2003, p. 4) report electricity generation and distribution efficiency gains from date of transfer until 1999: the reduction in the share of intermediate purchases as a share of gross value added fell by 17.2%, while in distribution the figure fell by 5.5%. In terms of labour productivity, GWh per employee rises by 17.4% for generators and by 31.5% for distribution companies over the period from transfer date to 1999.

[54] Newbery and Pollitt (1997) find that for the CEGB (responsible for generation and transmission of electricity in England and Wales labour productivity increased from 4.7 GWh generated per employee to 10.4 GWh generated per employee over the period 1985–86 to 1995–96. Domah and Pollitt (2001) found that in the distribution and supply businesses of the 12 regional electricity companies in England and Wales labour productivity increased from 2.5 GWh sales per employee in 1985–86 to 5.5 GWh sales per employee in 1997-98.

[55] See Bouille et al. (2002).

[56] See Ennis and Pinto (2002, p. 30).

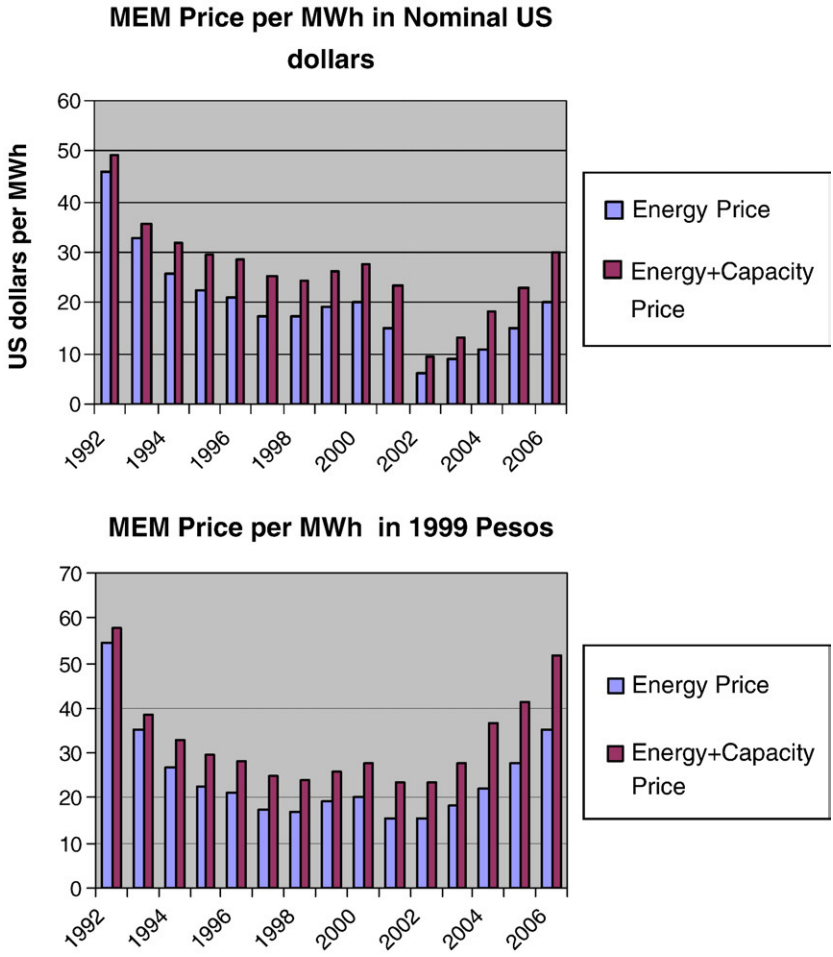

Fig. 1. Upper figure: Evolution of prices in bulk power prices in the MEM: energy price (blue (lighter) bar) and energy plus capacity price (red (darker) bar). Lower figure: Evolution of prices in bulk power prices in the MEM: energy price (blue (lighter) bar) and energy plus capacity price (red bar). Source: CAMMESA website, ENRE, INDEC Argentina and Central Bank of Argentina. Note: Energy+Capacity price is the Monomical price. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

3.6. Quality of supply

Quality of supply has improved overall within the Argentine electricity sector since 1992. Technical and non-technical losses have fallen sharply. The reduction in losses is shown in Fig. 3. For the utilities in the Greater Buenos Aires area the number of hours of supply lost per year was 21 in 1988, 16.8 in 1993/94 and dropped to 5 in 2000/01.[57] This reflects significant improvement in metering and bill collection to reduce non-technical losses (i.e. theft).

[57] See CAISE (2002, p.17)

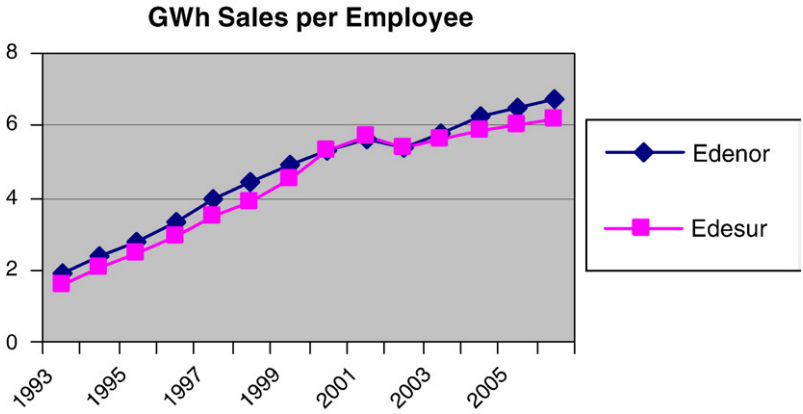

Fig. 2. Labour productivity in distribution companies in greater Buenos Aires. Source: Edenor and Edesur Annual Reports.

Power outages in the transmission system have fallen since privatisation. In the Transener transmission system the rate of own failures per year was 1.48 in July 1994 and was 0.57 in 2002 well below the limit of 2.50 set in the concession contract.[58]

3.7. Major problems in the pre-crisis period

The Argentine electricity system has operated effectively at the national level for almost the entire period from 1993 since the restructuring of the state owned system. The most serious problem the system actually had in the pre-crisis period was the infamous Edesur incident in 1999.[59] This was a serious power blackout in the city of Buenos Aires, which was handled badly by the private company involved and did much to damage the local reputation of privatisation. The incident shares some similarities with the Auckland Crisis of February 1998 when the centre of Auckland was without power for three weeks.

During the early morning of 15 February 1999 there was a fire in a new substation as it was being energised. This resulted in 156,540 customers being without power. By that night 60,000 customers were still without power. It was not until February 24 that the last customer was reconnected. The situation was poorly handled by Edesur, who continually promised that the problem would be solved imminently. The blackout occurred during some of the hottest days of the summer and led to street protests. Edesur compounded the bad impression left by the incident by their subsequent initial reluctance to fully indemnify losses. Eventually a fine of US$ 51 m was imposed on the company by the regulator because of the seriousness of the blackout and the total cost after compensation payouts reached around $80 m.

Since then there have been other serious incidents but these have not attracted the same level of fine as the Edesur incident.[60] There have been suggestions that recent power outages caused by shortage of capacity have been caused by strategic under-investment by electricity companies in generation, transmission and distribution. However there seems little evidence of strategic under-investment but plenty of evidence that prices are much too low to justify any additional investment

[58] See Transener Annual Report 2002, p. 21.
[59] For a full description and analysis of the incident, see Ullberg (2002).
[60] See for example 'Government could fine Edensor for power cuts', *Business News Americas,* 3 February 2004.

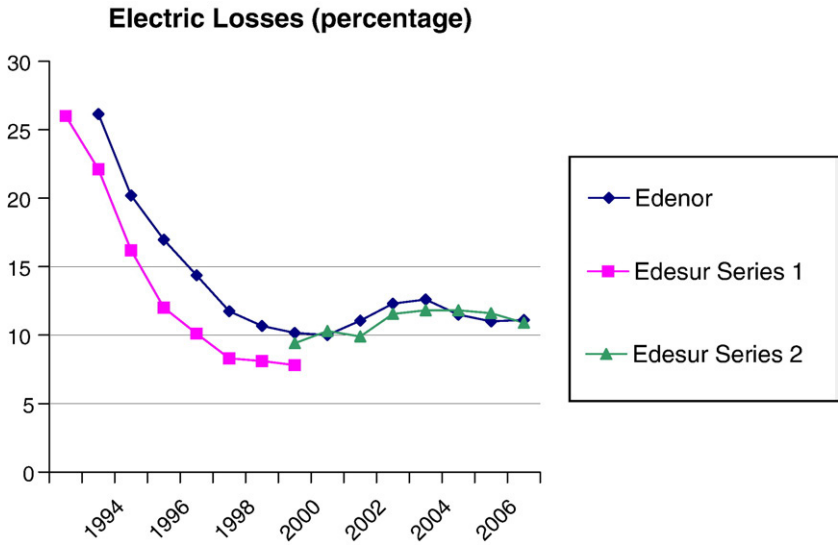

Fig. 3. Technical and non-technical losses (%) in Greater Buenos Aires. Source: Edenor and Edesur Annual Reports.

in capacity to increase quantity or quality of supply. It is rather ironic that the government accused private companies of strategically underinvesting in the sector in the wake of the Edesur incident but then did so much to cause underinvestment in the post-crisis period. If anything the Edesur incident illustrates the strong disincentives in terms of fines and public loss of reputation faced by private firms if they do not deliver agreed quality targets, in marked contrast to the situation which existed under public ownership.

4. Detailed lessons from the reforms of the argentine electricity sector

We discuss the reforms in detail looking at the issues under five headings: generation, transmission, distribution and retailing, practice of regulation and general institutional framework. In our view the picture that emerges is one of a system which has worked well and significant benefits until the macro-economic crisis and which has coped with the shock much better than a previous system might have done. In 1992, the design of the electricity market drew on best practice design experience at the time. We examine the Argentine experience in the light of best practice as it currently stands. To summarise these under each of our five headings:

A. Generation markets work best when characterised by a lack of integration with monopoly transmission and distribution networks, low degrees of concentration in the price setting segment of the market and when generators freely contract with customers.
B. Transmission systems need appropriate regulation of incumbents to ensure both fair prices and an adequate rate of return on investment. There needs to be an appropriately regulated institution charged with proposing and overseeing system wide planning to ensure timely building of new transmission links.
C. Distribution companies need to be regulated to ensure that distribution charges both incentivise efficiency and are fair. Third party access charge regulation is essential to ensure that customers than can switch suppliers have an incentive to switch to alternative suppliers

when these have lower economic costs than the incumbent distribution companies. Supply competition is itself feasible for all industrial and commercial customers and has been successfully implemented for residential customers in some countries. Supply competition requires adequate separation of distribution from retailing (supply) via effective legal unbundling of the two functions.

D. Economic regulation of the electricity sector is best practised by a single independent regulatory agency operating at the country level (for medium sized countries – by population – like Argentina) with minimal ministerial control. (Provincial as well as federal regulation is something of a luxury for a developing country.) Output based regulation using appropriate incentive mechanisms can deal with issues of quality of supply, network extension and consumer cross-subsidy which are the areas most subject to political interference. Electricity and gas are generally thought to be best regulated within the same regulatory agency, given the synergies between the sectors.
E. The general institutional environment in which the electricity sector is placed must be stable and foster long-term investment based on protection from arbitrary changes in government policy. Legislation regarding the electricity sector should be credible and sustainable. However there should be the capacity for the regulation regarding the system to respond to new information. The ability of the regulator and the Independent System Operator (ISO) to do this requires clear, timely and trustworthy dispute resolution/review mechanisms especially in the case of disputes between companies and the regulatory agency. Given the technical nature of many of the issues this should involve specialist arbitration panels perhaps under the authority of the general Competition Agency.

In what follows we discuss some of the lessons from the Argentine experience, bearing these best practices in mind. The aim is to highlight some of the details of the Argentine experience and the light they shed on reform in developing countries, not to provide a scorecard for the Argentine reform. In terms of the overall structural change in the industry — breaking up the incumbent companies, creating a competitive generation market and instituting a specialist regulator — Argentina followed best practice.

4.1. The generation sector

4.1.1. The Argentine electricity system illustrates the potential for larger developing countries to operate competitive power markets

Argentina's power market has successfully delivered low prices and reasonable rates of return for investors prior to the macro-economic crisis. There have been no problems of the strategic exploitation of market power due to both the cost based bidding system and the degree of competition in the market which has meant that generators have in general not even bid up energy prices to the maximum price allowed for their technology.[61] There has been significant new entry and so far the market share of the largest four firms has remained lower than in 1991. The system of independent system of operation and dispatch has worked well and supported the market. These observations are supported by the improvement in generation performance and the reduction in prices seen up until 2002 noted above.

[61] Ferreira (2002) finds that firms were not exploiting any market power within the Chilean market at the end of 2000. The prices which prevailed in the market were equal to those which a social planner would choose if she were determining which plants were dispatched.

4.1.2. The vertical separation of electricity generation from both transmission and distribution created a vigorous competitive market for industrial customers

Argentina has the least concentrated generation market in Latin America (Millan, 2007, p.65). Argentina learnt well the negative lessons from Chile about the need to separate electricity generation from both transmission and distribution (see Pollitt, 2004, for a discussion of Chile's electricity reforms and Millan, 2007, for a discussion in the context of reforms in Latin America as a whole). In Chile the continued integration of Endesa generation and transmission combined with negotiated third party access created hold up problems for other generators. This has not been a problem in Argentina where generation and transmission are legally separate. Similarly in Chile integration of Endesa generation and Chilectra distribution has made it difficult for other generators to compete for large customers embedded within the Chilectra distribution network. In Argentina these hold-up problems did not exist and there have been no incentives for distribution companies to prevent efficient financial bypass of their network. The result has been a very competitive market for customers who are allowed to switch supplier, where a significant percentage have left their local distribution company in the Greater Buenos Aires area.

4.1.3. A price based bidding could have worked in Argentina, whereas the actual cost bidding system could have been improved

There is little evidence of market power being exercised in the generation market. However the way capacity payments were paid could have been subject to market abuse. Generators did not get capacity payments for availability, as theory would suggest. Instead they received capacity payments only when they were actually running. This gave generators an incentive to underbid on their energy cost in order to ensure that they got to run their generating plants. This may have led to plants running out of merit order and could easily have been corrected by given capacity payments for availability. An alternative approach to eliminating this possibility would have been closer auditing of energy costs.

The Argentine energy market was very competitive unlike that in Chile, where simulations suggest that price based bidding would have led to much higher prices.[62] In retrospect it seems likely that a price based bidding system could have worked under the competitive situation of the Argentine market. Price based bidding systems, in theory, provide better signals for long term investment as dispatch is on the basis of the scarcity value of electricity rather than on the basis of current costs. Such a system would have reduced the transaction costs and scope for cost based gaming in the current system. The gains from switching to this system would initially have been small but might have provided less scope for government interference. It is interesting to note that the proposed reform in 1999 (Resolution 545) did include a provision for day ahead price based bidding in the energy market[63]; the 2001 reform also included a provision for a move to price based bidding.[64]

4.1.4. The long term contract market was negatively affected by the seasonal price that distribution companies paid for power

Distribution companies could only pass through the regulated seasonal price of electricity, which was an expectation of the spot price. This left little scope for a meaningful long-term contract market between generators and distributors. Distributors would never wish to pay a price

[62] See Arellano (2003).
[63] For the text of this resolution see http://infoleg.mecon.gov.ar/.
[64] For the text of this decree see http://infoleg.mecon.gov.ar/.

higher than the seasonal market price (as they could not get this reimbursed) and on average generators would only be interested in long term contracting if they could get a price greater than the average spot price. In the situation when the spot price was falling, as it was for most of the 1990s, distributors would be happy to purchase power spot. The absence of long term contracts is worrying in that long term contracting and price signals reduce the likelihood of future supply shortages by providing signals of future scarcity. A lack of long term contracting in the Californian electricity market was one of the key reasons for the financial problems experienced by electricity distribution companies during the 2000–01 power crisis.[65] The unwillingness of distributors to sign long term contracts in the context of a developing country with high and variable demand growth can expose the sector to unnecessary power shortage risks. In both the Californian and the Argentine cases regulation of distribution companies restricted the ability of the distribution companies to make sensible contracting arrangements.

4.2. The transmission sector

4.2.1. The system of regulated third party access charges for existing transmission lines did successfully ensure the revenue adequacy of the transmission operator

In contrast to Chile there were no problems of non-payment for particular existing lines in Argentina. Transener received enough revenue during the pre-crisis period to meet its concession obligations and to improve the quality of its service. There was no problem during the pre-crisis period of poor incentives to maintain certain sections of the network which were not being properly remunerated.[66] It is interesting to note that Chile eventually changed to the Argentine system of regulated third party access charging for transmission (see Pollitt, 2004).

4.2.2. The system of competitive tendering for new lines was successful

As in Chile, where a similar system exists, Argentina obliged all new public transmission investments above $2 m (on the 500 kV system) to be competitively tendered. This implied that the incumbent transmission companies did not have a monopoly on new lines in their areas. Between 1992 and 1997 there were four competitive tenders for nearly 2000 km of new lines. The first three resulted in new entrants, the final one (which attracted 12 bidders) was won by Transener. Littlechild and Skerk (2008-this issue-a,d) note that these tendering processes seem to have been competitive and have led to significantly reduced construction costs. The observation of such successful competitions for the building of new lines is a major learning from the Argentine experience for all electricity systems.

4.2.3. The Argentine system implemented an untried model of transmission expansion, which proved controversial

The 'Public Contest' mechanism of transmission system expansion was accused of being biased against investment in transmission. This was because payments for new lines were calculated on the basis of usage rather than economic benefits. If 30% of users objected on the basis of this charging mechanism then it would not go ahead. This is not a problem if the proposed new line is actually not a socially worthwhile investment, or not the best choice of an investment, or not a well-timed investment. However there is a danger that a socially desirable project would be missed because the beneficiaries did not have sufficient voting power within the process. This

[65] See Sweeney (2002).
[66] See Gomez-Ibanez and Rodriguez-Pardina (2001b).

was because if new lines were built every one who used the line would have to pay for it independently of how it affected their net revenues, giving greater weight to voters who lost a little, but used the line a lot, even if the overall economic benefits were positive. As Littlechild and Skerk (2008-this issue-a,b) point out there was an additional problem with this method which was that later users would be able to gain access to the line and reduce the benefits to the original proponents. If the line was built under a direct contract between a transmission company and beneficiaries of the line there were also potential problems (this was the 'Contract between Parties' method). In this case as new line access rights would not exclusively belong to those who paid for the line, thus it might be worthwhile to free-ride on the initial investment of others. This is because new users of the line might be able to pay just marginal usage costs.

The building of the fourth line from the Comahue to Buenos Aires illustrates the controversial nature of the 'Public Contest' mechanism for building new lines.[67] The failure to initially agree on the building of the fourth line has been seen by many in the industry as evidence that the 'Public Contest' mechanism was flawed. Proposals for a National Transmission Plan were promoted as a consequence of the perceived problems with the 'Public Contest' mechanism. However Littlechild and Skerk (2008-this issue-b) suggest that the evidence for such a position is weak. In particular they find that their cost-benefit analysis of the new line to the system indicates that the line was not worthwhile from an economic perspective. The line was delayed by 18 months as a result of initial disagreement. This implies that even if the benefits were positive the costs of delay were small. They also make the important observation that the voting system was successful in reducing the number of unnecessary and uneconomic transmission investments motivated by political interests. This had been a problem prior to privatisation, as regional governments lobbied for upgraded transmission links paid for by the system as a whole. Littlechild and Skerk (2008-this issue-b) also note that a delay of a year and a half is small compared to delays in the planning process for major transmission upgrades in Europe and North America.

A system of system wide planning is desirable and necessary in a developing country context. In a developing country large and economically timely transmission expansions are important to meet the demands of electrification and rapid economic growth. In advanced countries with very low demand growth nodal pricing (such as practiced in the PJM power market in the US) on the meshed transmission network may be a good way to price existing transmission capacity and may give good signals for transmission expansion along existing pathways. In developing countries with linear (rather than meshed or looped) transmission systems merchant transmission expansion may be a possibility, as it generally was in Chile (this is where dedicated transmission lines could be built (in theory) by third parties thus bypassing the main transmission system).[68]

System wide planning is useful for identifying transmission expansions that should go ahead especially in the light of expected rather than actual demand growth. In Argentina it would seem sensible that one institution is charged with producing a transmission expansion plan and given some power to commission new lines. Allowing private companies alone to decide on transmission lines with important implications for the location of future economic development is unlikely to lead to socially optimal (or indeed politically acceptable) outcomes. The case of the fourth line from Comahue to Buenos Aires, discussed above, illustrates this. Although the decision may have been questionable on economic grounds it would seem sensible to have a system which is, if anything,

[67] For details of the negotiations around the building of the fourth line see Abadala and Chambouleyron (1999) and Littlechild and Skerk (2008-this issue-b). For a critique of the voting system with the 'Public Contest Method' see Chisari et al. (2001).

[68] See Pollitt (2004).

biased slightly towards transmission expansion, rather than against it, as this promotes competition in generation. It is at least interesting to point out that of the other leading electricity reform nations – Chile, UK, Norway, Australia and New Zealand – all have system wide planning[69]. In suggesting this it is important to stress that the power to plan and implement transmission investments can be separated from the actual building of new lines. Incentives need to be in place to ensure that the system planner does not benefit unduly from over expansion of the transmission network and that alleged wider social benefits are evaluated systematically.The Argentine system successfully achieved the limitation on the incentives of the system operator to unduly benefit from system expansions via competitive tendering but failed to make anyone responsible for system planning.

4.3. The distribution and retailing sector

4.3.1. There is a need for a proper regulation of the third party access charge in order to correctly regulate the access to the monopoly distribution network by third party suppliers

In a competitive retail electricity market proper regulation of the third party distribution system access charge is essential. This charge needs to be set in such a way as to encourage economically efficient bypassing of the supply business of the distribution network (see Baumol et al., 1997). In theory this should be a component of the regulation of final electricity tariffs to regulated customers. As ENRE is the regulatory body responsible for regulating these tariffs, it should also be responsible for setting the distribution access charge. However the access charge was set by the Secretary of State. As there is not proper accounting separation of distribution and supply it is not clear what is the basis of the Secretary's decision. The suggestion was that, during the pre-crisis period, the access charge was set too low encouraging inefficient switching to alternative suppliers by non-regulated customers which results in regulated customers having to pick up the short-fall in distribution revenue created.

The current system is subject to both political interference and double jeopardy caused by the fact that both the regulator and the Secretary need to work out the efficient level of marginal costs in order to make their determinations and hence may use different numbers. The result of this will be to raise the uncertainty facing the revenue of the distribution company and likelihood of mis-pricing. The political pressure on the Secretary of Energy is for lower access charges for large free customers, allowing this in turn produces politically difficult pressure on the price paid by regulated residential customers. If it is the regulatory agency's task to regulate the profitability of the distribution company then it should have control over both the final price and the access charge. One charging regime for setting an efficient access charge is the well-known Efficient Component Pricing Rule (ECPR or Baumol–Willig rule).[70] Clear legal (and accounting) separation of distribution and supply businesses facilitates the setting of fair access charges.

4.3.2. Private ownership of distribution utilities combined with clear incentives to increase connection of poor customers can dramatically improve access among the poorest households

One of the striking achievements of the early years of Argentine electricity reform was the sharp increase in the number of poor households with electricity supply.[71] Between 1986/7 and 1996/7 electricity access rose from 65.2% for the poorest decile in the Greater Buenos Aires area to 98.98%. This was the result of the 4-year framework agreement following privatisation which saw government incentives paying off past debts of shanty town dwellers and paying for the

[69] See Sioshansi and Pfaffenberger (2006) for more details on each of these systems.

[70] For details see Armstrong et al. (1994).

[71] See Bouille et al. (2002) and Ennis and Pinto (2002) for discussions about the nature of the government's support for shanty town dwellers and the impact of privatisation on access to electricity.

installation of meters. Municipal governments paid for this with 60% of the tax on household electricity consumption, with the other 40% subsidising new connections. For the new customers Edenor and Edesur had an 85% collection rate with some direct subsidy coming from the government in the form of payment for very poor groups of consumers on municipal meters and payments for pensioners collecting the minimum pension.

Many developing countries face problems of improving the access of the poorest while giving financial incentives to companies to supply them. Argentina handled this problem in an economically efficient way. The increase of access to poor consumers was calculated to have yielded large increases in social welfare and be a significant benefit of the restructuring of the sector.

In contrast to its success in connecting poor urban consumers, the government has limited success in extending the electricity network to include 2–3 million inhabitants of rural areas without access to public electricity supply. In 1995 the Secretary of Energy launched a scheme to supply power to these areas.[72] The Disseminated Population Electricity Supply Program (PAEPRA) was to connect 314,000 rural users. Only of a fraction of those connections were actually put in by 1999. The main problem for the PAEPRA was the unwillingness of provincial governments to contribute subsidy payments.

4.3.3. The system of penalties for supply outages combined with the pass through of nodal prices to customers created perverse incentives for distribution companies

ENRE regulated distribution companies are directly liable for all failures to supply their customers regardless of the cause. In theory, where prices are not regulated, this should not matter for efficient investment in reducing the risk of supply failures. However in practice there are high transaction costs in writing supply quality contracts between transmission operators and distribution companies and a lack of incentive to minimise the total costs of electricity supply facing distribution companies. These two facts mean that distribution companies have had a strong incentive to minimise the risk of transmission failure by contracting with generators who are close by or even to engage in physical bypass of existing transmission networks. This may lead to under-utilisation of some parts of the transmission network and pass through of higher nodal power costs to customers.

4.3.4. The seasonal pricing system is unnecessary, inefficient and creates an opportunity for political interference

50% of electricity demand is subject to the seasonal price for purchased power. The purpose of this price is to reduce the exposure of residential customers to price spikes, which might exist in a hydro system in years of extremely unfavourable hydrological conditions. This is misconceived. In a completely free market, customers who value price stability can buy stable prices direct from their suppliers who will then absorb or re-insure against the risks of high spot prices. In other words long term contracts (which allow recovery of a surplus in periods of low spot prices to compensate for losses in periods of high spot prices) can be entered into if valued by customers. The problem when there are regulated customers who have only one supplier is how to encourage the optimal amount of price smoothing.

The Argentine seasonal pricing system[73] imposes smoothing by only allowing distributors to pass through the smoothed price. However the smoothing mechanism itself is problematic. It

[72] See Bouille et al. (2002).

[73] The Chilean node pricing system is similar and exhibited similar problems to those we identify for Argentina (Pollitt, 2004).

represents a six month forward looking average of electricity prices and is reset every six months. As pointed out above the existence of a seasonal price puts a ceiling on the amount that distributors can pay for purchased power. This has worked to inhibit efficient long term contracting.

An open auction for long-term contracts to supply regulated customers combined with some benchmarking of the long-term contract prices paid by the distributors on behalf of their regulated customers would ensure a large degree of smoothing. It would also ensure that high prices at times of shortage would be reflected (at least in expectation and in the price of un-contracted demands) in the regulated price. If there was still a need for smoothing the final price there could be a smoothing mechanism introduced on the final price to spread the payment for the high cost electricity by regulated customers. This could easily be achieved by a limit on the maximum price rise in any six month period followed by a period of over recovery in prices to make up any revenue shortfall to cover the extra purchased power costs.

A major problem with the seasonal price recently has been the fact that it is formally set by the Secretary of Energy. From 1992 until 2002 this price was set at the value suggested by the CAMMESA model. However following the crisis the Secretary of Energy set the price at a lower level than the model suggested. Normally this would be problematic because it would lead to a shortfall in what generators would get paid by distributors. However the Secretary also had control over the fund which balanced the differences between the spot prices paid to the generators and the seasonal prices by distributors. He was able to use the accumulated surplus in this fund (arising from the period when the seasonal price lagged the downward movements in the spot price) to bridge this deficit. If there is to be a seasonal price it should always be based on an appropriate computer simulation not on a political decision. The existence of this politically controlled intermediate price gave the government an additional lever by which to interfere in the operation of the market.

4.3.5. The final customer market could have been further liberalized

Currently customers with peak demands above 30 kW can choose supplier freely. Prior to the recent crisis the Argentine electricity sector had got all of the preconditions in force for full retail competition, as the ultimate target in the development of its electricity market. This would have important positive downstream effects in terms of reducing the degree of regulation in the industry and its potentially distortionary effects. Such a move towards full supply competition was part of the failed proposals for reform in 1999 (Resolution 545 of 1999). The advantages of full supply competition might include better long term contracting for electricity supply and the emergence of multi-utility consumer offerings should consumers value these. Besant-Jones (2006) in his substantial review of reform experiences suggested that such residential customer market liberalisation should be implemented as the final step in the electricity reform process in developing countries, but the preconditions he identifies were in place in Argentina before 2001.

4.4. The practice of regulation

4.4.1. Small users should have been formally represented in the regulatory process

One of the rationales for central government involvement in the electricity sector is to represent the interests of small customers. However this can be done directly by involving small users on the CAMMESA board and via a separately constituted consumer body to handle customer complaints (currently these are handled within ENRE). Such a body would have created an informed consumer voice, which might have reduced the need for the involvement of the Secretary of Energy in the process. It would also have educated consumers of the benefits of the reforms and need for a quicker resolution of the current payments crisis within the sector.

4.4.2. Accounting separation of distribution and retailing should have been a priority for the regulator

A notable failure in the practice of regulating the electricity sector has been the failure by ENRE to establish the detailed information collection systems on which modern regulation of incumbent network utilities depends. As we noted above there should be clear separation of the regulated and non-regulated businesses and between the non-competitive and potentially competitive businesses. If there is to be effective regulation of distribution access charges and further retail market opening it is essential to collect detailed information on distribution and retailing costs. Clear separation of distribution and retailing financial data has been a key part of the reform process in the European Union (Green et al., 2006). It was the strict separation of these costs in the UK that eventually led some regulated distribution utilities to realise that they did not benefit from integration with supply companies. This has led to the separation of many of the regional distribution wires businesses from the local retailing of power. ENRE has been existence for over a decade; most regulatory agencies make the establishment of appropriate financial reporting of component generation, distribution and retail costs by regulated companies a top priority.

4.4.3. Regulatory oversight of crisis management at times of supply failure is crucial

The success of any reform process is threatened by a badly handled supply failure. As Auckland (1998), Buenos Aires (1999), California (2000), New York (2003) and Italy (2003) demonstrate prolonged supply failures raise external questions about the efficacy of reform (see Bialek, 2004, who explicitly explores the reform-supply failure link in the later two cases). While supply failure penalties encourage investment to reduce supply failure risk, it is neither possible nor sensible to eliminate all risk of supply failure. This implies that there should be a crisis management plan should a bad supply failure occur. As the integrity of the system is called into question by such a failure it should be the job of the regulatory agency to ensure that all the relevant companies have an up to date crisis management plan. It should also be the case that the regulatory agency itself knows how to respond in a crisis. During the Edesur incident the company apparently did not have an adequate crisis management plan, particularly for handling the media. It also seems to be the case that ENRE did not have a similar crisis management plan and was itself slow to realise that its own competence and the competence of the whole privatised industry could be called into question by this incident.[74]

4.4.4. The regulatory agency, ENRE, enforced an arbitrary system of fines for breaches of quality standards

Distribution companies in Argentina complain about the enforcement of arbitrary quality standards by ENRE. ENRE were free under the legislation to define quality standards but these were significantly tightened during the 1990s to the extent that fine income was increasing in spite of the fact that general supply quality was improving. The effect of these apparently arbitrary standards was to threaten revenue adequacy and increase uncertainty. The serious 'Edesur incident' resulted in ENRE imposing a special fine of $100 m instead of the $10 m, which would have been due under the existing quality incentive scheme. Arbitrary fines of this nature violate the principle that fines should be levied on observed outcomes not on intermediate measures (such as the observation of management failure). The reason for this principle is to encourage efficient responses (especially among firms who are not fined) to well specified social preferences for quality.

[74] See Ullberg (2002).

Serious incidents, which call the existing penalty system into question, should be handled by ex post inquiry to learn lessons for the future. Edesur paid a much larger than anticipated fine rather than risk losing their concession, however in principle incompetent franchisees should not be given the opportunity to buy their way back into the franchise if the costs of leaving them in place in the future may outweigh the benefits. If ENRE were serious about learning the regulatory incentives from Edesur they would have enquired into it thoroughly. However there was not a full enquiry into the incident and the only document ENRE ever published on the incident was a chapter in their annual report. By contrast the 2003 New York power cut led to many pages of reports on the FERC website.

4.4.5. The regulatory agency, ENRE, has been politically undermined over the years

Instead of evolving a strong independent regulatory agency for electricity ENRE appears to have grown much weaker over the years.[75] This is because of continuing interference by the Secretary of Energy. This has manifested itself via: the pressure to impose a large number of penalties; the continuing role for the Secretary of Energy in the setting of the distribution access charge and the seasonal contract price; the delaying of the 2002 distribution price review and the long running renegotiations of the utility franchises post-crisis (which we discuss in Section 5). The number and quality of professional staff declined over time and for several months during 2002 and 2003 ENRE only had 2 commissioners out of 5. As ENRE needs 3 commissioners to pass any resolutions it was effectively unable to function during these periods. Once established by statute, regulatory agencies should not be subject to operational oversight from a government minister but should be subject to judicial review by the Competition Authority or the independent government auditor.

4.5. The general institutional framework

4.5.1. Individual electricity customers should be faced with market-based prices for electricity

Between 1992 and 2001 Argentina successfully moved from a pricing system for electricity in which many poor customers were allowed to avoid paying for electricity to one where those who could pay, paid something, and those who could not received a direct subsidy to pay their electricity bill. Many developing countries face this non-payment problem and have struggled to deal with it. Argentina dealt with it in a way that is consistent with the economic principle that re-distributions of wealth should be achieved via taxes and subsidies not via cross subsidy. This principle encourages more efficient and safe use of energy and encourages companies to connect poor customers to their networks (as was the case with shanty town connections). Since the crisis, artificially low electricity and gas prices have served to create a disequilibrium between the demand and supply of electricity. The experience of 2002–2007 and the inevitable power cuts and increased government intervention (see the next section) amply illustrate that the laws of supply and demand should be allowed to apply to the electricity market.[76] The long term consequences of low energy prices (especially for gas) in Argentina are reflected in substantial inefficiency in domestic energy consumption (see Gonzales et al., 2007).

4.5.2. In the electricity sector, as in the economy in general, one politically inspired distortion of prices and regulation tends to make additional political interference more likely

We have noted a number of examples of political interference in the Argentine electricity sector which have only led to further problems. These include: the keeping of the access charge in

[75] See Abdala (2001) for examples of the way that ENRE was undermined.
[76] 'The laws of economics bite back', *The Economist*, 24th April 2004, p.35.

distribution too low leading to pressure on residential rates; the restriction of the rise in final prices leading to payment problems in the generation market; and the failure to appoint directors to ENRE leading to the inability of the regulatory agency to function properly leading to more political input into the regulation. Successful regulatory regimes involve self-restraint by politicians and political institutions in what is often the complex business of setting the right incentives in the electricity sector (Green et al., 2006, make this case for the European Union). Arbitrary intervention by politicians in the operation of a decentralised electricity market is likely to have unintended consequences, because ministers are less able to make economically sound decisions than competent independent regulatory agencies. The setting up of a state owned energy company to respond to some of the 'market failures' associated with politically inspired price setting in the energy sector illustrates the vicious circle of ever increasing intervention to which badly thought out policies lead.

4.5.3. Government ministers should not be involved in approving or implementing regulatory decisions, which should properly be delegated to a regulatory agency

In general government ministers, such as the Secretary of Energy, should not undertake tasks that should properly be the task of regulatory agencies, such as setting regulated prices. They should not be able to control funds collected from electricity consumers for specific purposes, such as smoothing price differentials or paying for transmission capacity. Instead these funds should be in ring fenced accounts. In the case of Argentina there should have been no role for the Secretary of Energy in the governance of CAMMESA, in the setting of the seasonal price, in the arbitration of disputes or in the approving of regulated tariff changes or in the control of electricity specific funds. This could have been left to the rest of the CAMMESA board, overseen by ENRE. In Argentina the Secretary of Energy continued to control the operation of the electricity market and its regulation despite the setting up of an ISO and an independent electricity regulator via his control of the governance structure of CAMMESA and his authority over ENRE.[77] The government should restrict itself to broad policy objectives and avoid having anything to do with the day to day running of the current system (see Green et al., 2006).

4.5.4. ENRE, the regulatory agency, should have become a truly national regulatory agency with authority over all electricity utilities in the country

For a medium sized country – in terms of population – like Argentina the establishment of separate regulatory agencies for each province does not make much sense (Domah et al., 2002, discuss the human resource problems faced by regulatory agencies). Even in the UK where there is now a Scottish Parliament the interconnected electricity system in England and Wales and Scotland is regulated by the national electricity regulator, OFGEM. Germany has recently been forced by the European Union to introduce a national energy regulatory agency, having previously left regulation of distribution utilities to its regions. The seasonal pricing mechanism in Argentina was motivated by the inability to get the provinces to standardise their distribution tariffs. Distribution access pricing rules and regulated customer seasonal price pass through arrangements can differ by province. Many regulatory agencies in the provinces are small (they range from 7 to 40 staff and often cover several industries)[78]. ENRE has played a key role in providing support to provincial regulatory agencies. These agencies have limited capacity to regulate distribution and retail tariffs. ENRE itself would benefit from extension of its role as it

[77] See Rodriguez-Pardina (2004) for more details.
[78] See Estache (1997).

could undertake benchmarking exercises between the large number of distribution utilities that there are in Argentina as opposed to the three that it regulates. Thus a useful way forward might be to merge all of the provincial regulators into one body[79], though this poses political problems given the unwillingness of the provinces to cede power to the central government.

4.5.5. The weakened position of the regulatory agency, ENRE, by 2002 was not inevitable

The government has let ENRE's credibility and expertise wither away because of deliberate policy. While this is understandable given the magnitude of the macroeconomic crisis, it was not the only strategy available to them. It reflects an unwillingness to deal in an economically sensible way with the payments crisis facing the sector following the crisis. Weakening ENRE has prevented the regulatory agency taking a lead role in assessing the financial requirements of the industry as part of a pricing negotiation with the companies. The current strategy stores up trouble for the future as it demonstrates a predisposition on the part of state to circumvent an independent regulatory authority when convenient, rather than work with it. It is not an optimal policy response to a macroeconomic crisis to throw out what should be one of your most effective microeconomic institutions. It is interesting to observe that the inevitable political response to a crisis in the electricity sector is not to always get rid of the electricity regulatory agency or weaken its powers. The two agencies responsible for the regulation of the Californian electricity market (the FERC and the local California Public Utilities Commission) were heavily criticised but they did not have their powers weakened (see Sweeney, 2006).

4.5.6. In an economy with significant overlapping electricity and gas interests the gas and electricity regulators should be merged

Currently there are separate electricity and gas regulators in Argentina. This has created inconsistencies in the way that the gas and electricity markets have been handled in recent years.[80] There is no spot market in gas and the gas price has been fixed in Pesos. This has led to scheduling distortions between stations using Argentine and Bolivian gas. There is a need to co-ordinate the expansion of the gas and electricity networks to ensure least cost optimisation of the two networks. There is a strong possibility of efficient arbitraging between the gas and electricity markets to make optimal use of energy. To achieve this there is also a need to co-ordinate the regulated rate of return and the congestion charging regimes in the two networks in order to prevent inefficient arbitrage. Merging the regulation of the two sectors would ensure regulatory consistency.

5. Post-crisis developments[81]

Following the macro-economic crisis government intervention in the sector provides a rather different set of experiences to share with other countries. Electricity prices were fixed in pesos, while most debts were denominated in US dollars.[82] This resulted in widespread defaulting on debt payments and significant losses of shareholder value. Transener had a loss of 121% on shareholders equity.[83] This reflected a sharp decline in income as a result of the crisis and

[79] See Artana et al. (2001).
[80] See Abdala (2001) for an articulation of this view.
[81] For a useful discussion of early post-crisis developments see Nagayama and Kashiwagi (2007, pp. 123–125).
[82] External debts of the electricity sector were $4.3 bn at the end of 2001 (CAISE, 2002, p. 21).
[83] Transener Annual Report and Financial Statements 2002, p. 69.

exchange rate losses on debts. Distribution companies also posted big losses.[84] Edenor had a 30% loss on start of year shareholders' equity in 2002 and Edesur had financial losses amounting to 13% of start of year shareholders' equity.[85] Generation companies announced significant losses for 2002.[86] Foreign currency investors saw the foreign currency value of their remaining shareholder funds decline by at least two thirds. The UK's National Grid sold its stake in Transener for less than 10% of its pre-crisis investment value in March 2004.[87] France's EdF announced in April 2007 that it wished to sell its remaining stake in Edenor, having already sold the majority of its holding.[88] Electricity firms pointed out at the start of the crisis that at current price levels new investment was not profitable and supply shortages were likely in the near term if low prices continued (CAISE, 2002). Pesification did lead to the collapse of new investment, foreign debt defaults and significant non-payment risks. These arose from the increase in bad debt among final electricity customers and the fact that spot prices for generated electricity are not being fully passed through to regulated customers running down the reserve funds of CAMMESA and requiring the government to loan CAMMESA money.[89]

Fig. 1 shows the government's political problem: the real peso price of wholesale electricity, after accounting for recent nominal rises, is significantly higher than before the crisis. This is in spite of subsidised gas prices. Raising the price of electricity to reflect international prices of gas and to recover rates of return on investment would necessitate sharp relative real price rises for electricity. In response to the payments crisis in the sector the government has engaged in a lengthy negotiation process with the private companies to mitigate the consequences of the initial price freeze. In 2003 it established a government agency – Unit of Analysis and Renegotiation of Public Service Contracts (UNIREN) – to renegotiate 64 utility contracts within privatised industries (including water, transport, telecoms and gas, as well as electricity).[90] Negotiations were difficult and subject to political gaming as the Kirchner government made keeping inflation down by price controls an important part of its electoral strategy. Initial agreements were reached only by late 2005 and implementation was scheduled intially for December 2005 and postponed until December 2006, when most of the incumbent electricity firms had their settlements ratified by parliament. This involved a rise in average prices for the largest distribution companies of 28% backdated to November 2005. As of mid-2007 the status of the main transmission companies negotiated tariff increase is unclear. These price rises are now being implemented.[91] This is against a background of consumer price inflation of 80% over the crisis period.[92] In the wholesale market generators have seen prices rise as a result of mechanisms to compensate them for the higher peso costs of fuel imports. There have been separate negotiations over higher prices in return for new investment. In addition rising demand has raised the wholesale price. However in spite of this the

[84] Estache (2004) discusses the theoretical effects of pesification combined with a tariff freeze on distribution company profits.

[85] Edenor Annual Report and Financial Statement 2002, p. 2.

[86] Total Fina Elf report a 431 m Euros loss in Argentina in 2002 (Total Fina 2002 Form 20-F), Endesa Argentina a $454 m loss in 2002 (Endesa Annual Report 2002, p. 72–3).

[87] 'LATIN AMERICA: National Grid to exit Argentina's Transener with sale to local fund', *Platts Global Power Report*, 25 March 2004.

[88] See www.edf.com.

[89] For example in July 2004 the government loaned CAMMESA around $250 m in order to compensate generators for the difference between what distributors are paying in respect of regulated customers and spot prices (See 'Argentina Grants Electric Grid Operator New ARS300M Loan', Dow Jones International News, 2 August 2004).

[90] See: www.uniren.gov.ar. UNIREN replaced an earlier agency created in 2002 (Nagayama and Kashiwagi, 2007).

[91] 'Regulator applies Edenor, Edesur rate hikes', *Business News Americas*, 6 February 2007.

[92] Source: www.indec.gov.ar.

average price per MWh in the power pool in 2006 was only $30 US per MWh[93], an amount low enough to ensure that no private generator (without government support) was initiating new generation investment in spite of power shortages.

The consequences of the prolonged failure to reinstate market determination of prices were all too easy to predict. Low electricity prices have led to a rapid growth in electricity demand which has rapidly eroded the reserve margin. In December 2006 maximum demand in the MEM system was 4400 MW above the level of December 2002 while only 1200 MW of capacity was added over this period. Government subsidies to the wholesale power market to prevent prices increasing are reported to be around 0.5% of GDP.[94]

The return to poorly discriminating price controls – i.e. low prices for everyone, including the rich – to protect poor customers is a retrograde step. This situation has had seriously negative effects. At the beginning of 2004 capacity shortages led to cuts in supply to industrial consumers. In April 2004 there was a serious power loss in the Buenos Aires area which led to the network operating at lower than normal voltage. In March 2004 the government unilaterally cut gas supplies to Chile by 15%[95] in order to raise the amount of gas available for consumption in domestic power plants. Exports of electricity to neighbouring countries have also been restricted. Such actions have not addressed the fundamental problems facing the sector since the crisis but have served to worsen international relations in the region.[96] Economists estimated that Argentina's growth rate was to be 2% lower a result of the shortage of electricity in 2004.[97] There have also been severe problems in the electricity distribution system. In early January 2005 there were prolonged service disruptions in the Buenos Aires area for up to 15,000 customers. These were interpreted by the government and ENRE as evidence of under-investment by the three Buenos Aires distribution companies. The companies were fined for not investing enough, as well as for the outages themselves.[98]

These effects have been prolonged and seem to be getting worse. Recently, cold weather in May 2007 led to supply interruptions including school closures.[99] The government have been forced into increasingly desparate measures to ensure supplies, such as importing more gas from Bolivia, more electricity from Brazil and proceeding with expensive international hydro-power projects (Yacyreta, which relies on Uruguay's agreement) and proposing new nuclear power.[100] In addition Argentina's gas reserves, whose capped prices have also been pesified for internal customers, have been depleted

[93] Source: www.cammesa.com.ar.

[94] See 'Competition and prices policies: Price Controls', *Economist Intelligence Unit* – Country Commerce (Argentina), 23 July 2007.

[95] This action violated the 1995 Energy Integration Treaty between the two countries. This treated states that supplies can only be cut in proportion to the energy shortage within Argentina. This would have implied a 5% cut in gas supplies (See 'What sort of neighbour is this?', *The Economist*, 15th May 2004, p.34).

[96] Restricted Argentine gas supplies have led Chile to switch to expensive fuel oil for electricity generation and have put pressure on its transmission network as changing plant availability have reconfigured power flows across its power grid. Argentina has agreed to import more gas from Bolivia. However the Bolivians have an old border dispute with Chile which has led them to stipulate that none of the extra imports be used to increase the flow of gas to Chile. (See *The Economist*, 15th May 2004, op.cit.)

[97] See Adam Thomson, 'Argentina's lights grow dim as energy crisis hits home', *Financial Times*, 5th April 2004, p.7.

[98] 'Editorial: Argentina Distributors fined $33-mil after blackouts', *Power in Latin America*, 21st January 2005 and 'Govt. fines BA distributors US $4.4 mn', *Business News Americas*, 12th January 2005.

[99] See B.Faries and E.Raszewski, 'Argentina Rations Gas to Companies, Chile Amid Cold', *Bloomberg.com*, 29th May, 2007 and 'Argentina Caught Short: The government's populist energy policies are beginning to cause chaos', *The Economist*, 14th June 2007.

[100] See J.Dizard, 'Time to pull the plug on Argentina's GDP warrants', *FT.com*, June 11 2007.

much more rapidly than predicted, due to a combination of increased gas for electricity consumption and the inefficient conversion of two million cars to run on cheap natural gas.[101] Rationing of Argentinian gas to Chile has continued,[102] necessitating a major rethink of Chilean energy policy. This has involved a significant investment in liquified natural gas import facility to reduce dependence on Argentine natural gas by 2009 and the opening of negotiations with Bolivia and a rise in energy prices.[103] In distribution and transmission new investment has only been possible due to agreements involving government subsidy and additional client contributions.[104]

In early 2004 the government announced a first package of measures aimed at addressing the energy crisis.[105] This included a timetable to raise the industrial price of electricity to the competitive level within 18 months (prices had already begun to rise) and an incentive scheme for domestic users of electricity. The incentive scheme suggested that the marginal price of electricity would rise by 50% for units in excess of 95% of the previous year's consumption. These measures formed part of the 'Integral Energy Plan', published in May 2004, which included price rises for domestic natural gas and plans for a state energy company to facilitate investments in fuel production and transportation infrastructure. This company, Enarsa, was approved by the Congress in October 2004. In the meantime Argentina has solicted bids from Brazilian generators to supply up to 500 MW to maintain supplies in 2005.[106] The government has also completed negotiations with generators to turn 65% of their credit balances with CAMMESA over the period 2004–2006 into a fund to finance up to 1600 MW of new capacity.[107] However these measures look unlikely to bring an end to the crisis soon. Indeed it now appears that Argentine GDP growth will be constrained to meet the available electricity capacity and be at the mercy of the amount of rain in the hydro-electric dams and the reliability of individual plants on the system.

It is worth noting that the recent macroeconomic crisis has been accompanied by only a small upturn in the measured losses (see Fig. 3), possibly due to a combination of increased theft, under-investment and fundamental supply shortage. However the fact that this rise has been reasonably modest reflects well on the privatised companies. In spite of problems with supply and demand imbalance the private distribution companies have managed to maintain the frequency and duration of interruptions at similar levels to 2002 in the period to 2006. This suggests that private companies can deliver significant improvements in quality of service and that this is a major benefit of the reform process.

The magnitude of the macro-economic shock makes it difficult to believe that the majority of the problems experienced by the sector since February 2002 could have easily been avoided. However the unwillingness of the government to re-establish market determined prices does seem to have prolonged the financial stress of the electricity sector and have led to operational problems which could have been avoided.

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[101] 'Argentina: Energy Poor', Economist Intelligence Unit – Business Latin America, 18 December 2006.

[102] See B.Faries and E.Raszewski, op.cit.

[103] See J.Webber, 'Chile gas talks could herald Bolivan thaw', *Financial Times*, 31 July 2007.

[104] See 'Argentina: Edesur and Edenor boosted by clients' contributions', *La Nacion*, 17 April 2006 and Littlechild and Skerk (2008-this issue-c).

[105] This private use of gas has exacerbated the shortage of gas for electricity generation (See 'The laws of economics bite back', *The Economist*, 24th April 2004, p. 35). For details of the 'Integral Energy Plan' see Adam Thomson, 'Argentina announces new state energy company', *Financial Times*, 12th May 2004.)

[106] 'Argentina prepares to solicit bids for 500 MW of supply from Brazil', *Global Power Report*, 23rd December 2004.

[107] 'Argentina Moves Along With Govt Power-Plant Fund', Dow Jones International News, *7 February 2005.*

6. Conclusions

Argentina's electricity reform contains two sets of lessons for developing countries. First, comprehensive electricity reform can work in a developing country. Second, well organised markets and effective network regulation are undermined if there is undue political interference in the pricing of electricity.

Argentina's electricity reform is a fascinating test case. It represents the application of a combination of the successful Chilean and UK electricity models in a developing country context. Between 1992 and 2001 the reformed sector functioned very well. The generation market was very successful and was the least concentrated generation market then operating anywhere in the world. It managed to deliver falling prices, improving productivity and new investment. In transmission and distribution private ownership was successful at improving technical and cost efficiency and increasing investment. However some challenging regulatory issues did emerge. In particular the process for approval of large transmission upgrades was controversial and the regulator was subject to political influence, which unnecessarily increased the uncertainty of the regulated revenue of network companies. Private ownership and the private institutions of the market (CAMMESA and the various industry associations) performed well. However the problems that existed in the sector prior to 2002 had been widely recognised and some were in the process of being solved.

Millan (2007, p.247) describes the Argentine government attitude to the private electricity industry post-crisis 'a classic example of opportunistic behaviour by governments'. At the heart of any well functioning private industry is the operation of the fundamental laws of supply and demand. This implies that prices must be allowed to rise to bring the supply and demand for electricity into balance. Electricity sector reform requires a minimum commitment on the part of the government to market based pricing of energy and to a stable regulatory environment. Clearly the macroeconomic crisis of 2002 profoundly affected the Argentine economy as a whole and the electricity sector in particular. Some emergency measures for the relief of the poorest customers were undoubtedly required in the sector after the crisis, while large one-off exchange rate losses on the part of private electricity investors would seem to have been unavoidable. However the government's unwillingness to establish a timely and credible pathway back to the normal operation of the laws of supply and demand has resulted in under-investment, supply shortages, worsened international relations and a curbing of overall economic activity. The sector's recent problems are a reminder of the poorly run, state controlled electricity sector which Argentina temporarily left behind between 1992 and 2001. The experience of 2002–7 provides strong additional support for the rapid re-establishment of the successful private sector electricity market model which was operating in Argentina prior to the crisis.

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