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Incentives to invest in liberalised electricity industries in the North and South. Differences in the need for suitable institutional arrangements

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Summary

The stake of investments is all too often underplayed in deregulation reforms focused on market rules and de-integration measures.
1/ The presentation criticises first the optimistic approach of the theory of investment incentives through market signals when it is applied to deregulated electricity industries. The greater part of the investment in base-load and peak equipment should be made profitable by income from very high price during peak and extreme peak periods. Next, there is a problem of political acceptability, as the wholesale prices may reach extremely high and often unexpected levels and the system may face risk of shortage in the period of needs of new capacities.
2/ The problem is then addressed in the context of the mature electricity industries in North countries. Given the maturity market, a number of corrective solutions of the pure market model could be envisaged to enforce the incentives to invest, but none of them is a perfect one. The main way is to focus on adaptation of market rules on the supply of power at peaks and extreme peaks by considering "capacity adequacy" as a public good (with three solutions: capacity payment, reserve obligations, centralized procurement by auctioning for peak capacity). The observation of reforms suggests also the validity of some other solutions based on a limitation of the competition by allowance for long-term contracts and vertical integration between production and supply. The Transaction Cost Theory gives a justification of the recourse to these ones. Observation suggests also another solution in opposition with the canonical approach of the competition, the regulatory tolerance for horizontal integration and smooth market power exercise, which implies a specific political culture to tolerate it.
3/ Finally the question is extended to the specific problem of developing countries characterized by irregular growth. It is argued that reforms must be designed in view of the importance of the investment stake through long-term co-ordination and reduction of investment risks. Indeed experiences of Latin American liberalised industries show that they have to include a number of competition-based imperfections and to allow ongoing exercise of market power in order to allow prices to rise above competition prices. The Single Buyer model or some variants of it appears to be a good alternative if one wishes to avoid the twists and turns of the competition paradigm. The difficulty with this model raises from the institutional conditions to make it efficient and not overcostly.

Introduction

The stake to invest is all too often underplayed in deregulation reforms in electricity industries which are based on confidence in market signals to orient the long term choices of market players. It usually takes a crisis, caused by lack of investment in production and transmission, before anyone takes proper account of these stakes by improving the reforms. In industries in developed countries, the reforms initially benefited from a situation of overcapacity, as was the case in Europe. However, demand for electricity is continually increasing and the need for new capacity must be included at both peak and base-load times. The new market and regulatory institutions have not yet been properly tested to assess their capacity for turning the increasing scarcity of capacity into incentives to invest in production and networks. A striking example of this is the Californian market crisis of 2000-2001, which dramatically combined this issue with the deficiency of a market design that was too decentralised and complex and thus favours the exercising of market power, triggering intense debate in the United States and Europe on the matter of investment incentives.

In developing countries, the problem of incentives in deregulated electricity industries also has another aspect. The electrical reforms imposed by the international financial donors were all aimed at resolving the problem of financing investments in the context of the ongoing debt crisis. The main aim was to attract private capital for the financing of new investments, a step that demands an improvement in efficiency and performance levels within the sector. The paradox, however, is that when the competition-based models adopted in North countries for mature power industries are pasted as it were onto these electricity systems, the long-term investment conditions are all too frequently overlooked by the reformers and their advisers. These electricity systems grow quickly but irregularly and frequently rely on hydroelectric production that exacerbates the problem of incentives by the increase of the price volatility affected by the random in hydraulicity. What is needed is regulation and "institutional arrangements" that are appropriate for these conditions[1]..

This paper deals with the deficiencies of the investment incentive frameworks in the deregulated electricity industries. First it deals with the optimistic theoretical approach of investment incentives through market signals in deregulated electricity industries. It then addresses the problem in the context of the mature electricity industries in North countries by laying emphasis upon the usual focus on the capacity adequacy during the peak period. The question is then extended to immature markets of the South countries which have to deal with irregular and rapid demand growth.

1. The optimistic theoretical approach of market mechanisms

The aim of market players is initially to search for profitable outlets for their equipment, not to satisfy the demands of the market as a whole at a reasonable cost, as was the case in the former regulated monopoly situation. The principle of co-ordinating investment on the basis of a long-term forecast in the regional or national area of the legal monopolies is no longer

[1] At this stage, we could quote Alfred Kahn, the initiator of the air transport deregulation policies in the United States and an excellent observer of network deregulation policies who have a stance in favour of vertical integration as the best "institutional arrangement". It acknowledged that he was "intrigued by the specific nature of electricity. I always had doubts about eliminating the vertical integration of that industry. Perhaps this is one industry in which such integration works well" (*Business Week*, April 27, 2001).

there. The development of new capacity has a very specific character in the new electricity markets, because of their exceptional volatility, as will be seen later. The construction of capital intensive equipment must be decided upon without a guarantee of stable outlet or any stable anticipation of revenue and *cash flow.* The great volatility of markets in peak and extreme peak situations which is combined by low price during seasonal or structural overcapacity makes it very difficult to manage risks properly, as it is impossible to make profitability forecasts sufficient to include a large risk premium.

At the same time, it must be understood that investment in electricity production and transmission does not merely work towards production of energy and its exchange between a producer and his future clients, but also towards technical reliability and "capacity adequacy" of the overall supply, that could become critical at peak times with un-coordinated decentralised investment decisions. Technical reliability is already considered as a truly collective good, because of the many externalities that instantly generate a large number of technical flows associated to bilateral and multilateral exchanges (Abbot, 2001). Without co-ordination of the flows introduced by a technical authority, product quality and stability of supply will be affected to the extent at which the whole of the instant supply collapses. Reliability is unanimously considered as a collective good to which every production unit must contribute without rivalry or exclusion, and which benefits every network user and electricity purchaser in the same way. But there is large debates and disagreements about the very nature of the "capacity adequacy" which is a medium-term view of the reliability during peak periods, despite the fact that a capacity deficit during peak which would result from uncoordinated investment in peak and base-load equipment. The advocates of the unrestricted market argue about the efficiency of investment incentives given by market signals and the possibility to have a treatment of the capacity adequacy directly by the consumers. But these latter have clear social limitations in terms of acceptability.

1.1. The canonical market approach of investment incentives

The issue of maintaining reliability of supply and of investment incentives has not greatly interested the promoters of electricity reform, as one of the designers of the initial pioneering reform in Britain recently lamented (Shuttleworth, 2002). The reason for this was the theoretical optimism concerning the capacity of each market to direct properly the market players' investment and the decisions to enter into an uncertain situation. As the prices are supposed to reflect the conditions of short-term supply and demand without distortion and the investments are based on considerations of profitability, the spot market signals would be sufficient for encouraging and directing investments (Crew & Kleindorfer, 1986). The market forces would implicitly ensure the optimal level of reliability sought both short-term and long-term, by determining the peak prices by supposing an instant demand answer to change of hourly price. Their value would direct the development of peak offers in relation to an implicit failure values and so the marginal utilities of the peak power for the different type of electricity users. Their value also contributes significantly to the use value of the new base-load equipment, given its involvement in the peak supply.

Under these conditions which imply no restriction put upon the price move, the market signals would be sufficiently effective to orient investors' choices towards the optimal type of equipment according to the annual sales period targeted, as the regulated monopoly would do in order to satisfy long-term demand in its supply area: equipment with low investment costs but high operating costs for the peak time and more capital-intensive equipment and low operating costs for the base or semi-base period (Hunt, 2002).

The competition-based market would guarantee the collective efficiency of the competitors' investments on the basis of the net discounted value of the equipment to be installed. In this design, the entry of producers not vertically integrated and not involved in long-term arrangements with suppliers would be a natural way to develop capacities, as confidence has been established in the quality of competition on the wholesale market and the liquidity of the bilateral contracts market (Newbery, 2000, p. 417). The liquidity of the markets would ease the allocation of factors without running a risk of excess entries. This market path would be allowed by the technological progress. The entries would be facilitated by the presence of market-divisible techniques, an example being the gas turbine technique: the existence of such techniques would allow the market risk to be limited.

Still from this point of view, the electricity market would correspond to a classic asset-commodity market with a classic price cycle with a high price step accompanying the construction of new capacity. If the market prices are subject to daily, weekly and seasonal volatility, which reflects the tension between instant supply and instant demand, they also follow a structural cyclical movement caused by rigidity of supply and demand over a long period (construction period, life span of equipment, time taken to adapt to demand). This cycle shows itself in a significant increase in seasonal volatility during the step of scarcity on capacity reserves. In order not to distort the adaptation of supply to meet demand, price movements must be allowed complete freedom of play regardless of their magnitude and level of volatility (Ford, 2001).

Still from this point of view, the "capacity adequacy" has to be managed also from the consumer part. Reliability (or security) and capacity adequacy should be considered as two separate goods. Instant reliability can not be treated as a private good because of inherent externalities between physical flows; it is managed by the System Operator to which technical authority has to be given on the commercial transactions for offering the "reliability" of the system with resources procured competitively by complementary markets such as the balancing mechanisms. On its side "capacity adequacy" in peak should be treated as insurance against temporary price spikes or shortages (Stoft, 2002 ; Oren, 2003). Such service can be treated as a private good with each consumer able to choose their level of protection and choosing among a range of contracts of hedging. This insurance system with its variety of contracts would contribute to the profitability of new peak and base-load equipment.

1.2. The economic and social limitations of the pure market incentive system

The justifying reference of a commodity price cycle that should be left to develop unhindered is untenable, because of the shortage risk and the significant price volatility. The long cycle shows itself by the extreme amplification of the seasonal and daily volatility during the stage of capacity tension. The main reason of this exceptional volatility is the inelasticity of instant demand, which authorises very steep price rises without even the explicit collusion of the producers: "on a market on which consumers cannot react to prices in a situation of severe capacity tension, there are no limits to the prices that the producers can fix when a shortfall appears" (R. Green, 1998).

By comparison, aluminium prices oscillate between USc 50 and 10 per pound and oil prices between $10 and $30 per barrel, while gas prices can vary by 50% around the average price. Electricity prices, meanwhile, can show seasonal fluctuations of 200-300%, with still higher peak price episodes with a factor of 50-500 lasting for a few hours or a few weeks with any possibilities to anticipate their duration. Price volatility reaches an astonishing level of

€10,000 per MWh on some regional markets in the United States; it is slightly lower in Europe with extremes of €1,000 per MWh and daily averages of €120 per MWh, as occurred in Norway on several occasions during the long winter 2002-2003 session, marked by a scarcity of water resources.

The most liberal point of view, which states that these daily price movements on the market should not be hindered regardless of the magnitude and duration of the price peak, in order to allow investments in peak capacity and base-load equipment, is untenable. It poses a twofold economic and political problem.

- There are *two economic drawbacks*. Firstly, the very high price volatility creates a significant uncertainty of return on investment, both for peak equipment and for base equipment (for which, as already pointed, the greater part of the investment should be made profitable by income from peak and extreme peak periods).

  Secondly, this volatility expresses itself in a counter-cycle effect, which is very negative in the eyes of lenders and investors. Experience has shown that the investments encouraged by recurrent price peak episodes but based on uncoordinated decisions lead to situations of overcapacity, which in turn cause annual averaged prices to drop significantly, that is, below the total cost of the new units. These market over-reactions, which are frequently observed, can lead to bankruptcy for entrants who are not vertically integrated into the supply, or do not have outlets guaranteed by long-term agreements with suppliers at guarantee prices. This led to the failure of all the *merchant plants* in Britain in 2001-2002, following the transition to NETA and its consequent steep drop in wholesale prices from €35/MWh in 2000-2001 for the ex-pool to €23/MWh in 2002-2003[2]. On the North-Eastern markets in the United States, the independent producers who were attracted by the increased price levels also suffered failure after 2001.

  In systems in which hydroelectricity occupies a position of importance, as in the markets in Scandinavia, Central and Southern Europe (Austria, Spain, Switzerland), some deregulated North American markets (British Columbia, Ontario and California) and most of the systems in Latin America, the system is also conducive to significant market price volatility levels. The possibility of storing water leads to the problem of inter-temporal optimisation on inter-seasonal and sometimes inter-annual horizons, which must include the anticipation strategies of producers in competition and speculation on the value of the MWh in peak periods. In a dry year, of course, prices will be highly volatile, and this volatility may be further increased by upward speculation from producers.

- Next, there is a *problem of acceptability*, as the wholesale prices may reach extremely high and often unexpected levels and the system may enter a situation of tension over peak reserves with the risk of a shortage and cut in supply. This long term way of

[2] These British *merchant plants* must be distinguished from the investments made by the minority subsidiaries of the former regional REC distributors in production between 1990 and 1998. It will be noted that some people wrongly take these entries into production, linked to the RECs, as proof that entry and investment in a competition-based market is possible without problems. Rather, it is proof that these entries were ineffective, as the electricity sector was in an overcapacity situation when the market was deregulated. (The investments made by these minority subsidiaries of the 12 distributors were rendered "bankable" by the respective long-term contracts signed between them at guaranteed prices and with excess costs in relation to the pool prices that could be passed onto the residential tariffs in the regulator sector, which was maintained until 1998).

functioning is in fundamental contradiction of the justifying aim of the reforms, which is to reduce costs and improve prices and customer services in the electricity industry (Hughes & Price, 2002). The considerable difference between price and marginal cost and the shortages is not received at all kindly by the public opinion and the political system. The regulators therefore choose the solution that is rejected by the supporters of the market mechanisms (Stoft, 2002; Wolak, 2001) by imposing a price ceiling (for example, €1,000 MWh on the North American markets such as PJM, New England, New York and Texas) in order to prevent the prices reaching the extremely high levels for a shorter or longer period.

One solution, discussed at length in the current American debate, would be to improve the natural functioning of the market in order to reduce the magnitude of price movements and spread out price peaks in order to make them easier to forecast in terms of duration and variation. Many actors recommend making demand sensitive to short-term prices through pass-through of wholesale price moves onto the retail prices and to organise incentive to voluntary reduction of electricity consumption (Wolak, 2000; Stoft, 2002)[3]. There is however no guarantee that reducing price volatility is a sufficient solution to allow investments that will guarantee availability of supply at peak times or, more generally, investments for peak end base-load production.

The equations of the incentives to invest and the establishment of insurance contracts to manage privately the offer of "capacity adequacy" remain both difficult to solve. Concerning the incentives to invest, first it is the income generated during the price rises at peak and extreme peak levels that will allow sufficient annual income to be generated to make the base and semi-base investments profitably, provided there is no overcapacity (Stoft, 2002). Second for the new peak equipment, their profitability will be heavily dependent of two very uncertain parameters: the peak prices in the next years and their production which will depend upon a number of variables (temperature, resource in hydraulic reservoirs, etc).

Face to these risks, the financial hedging techniques (options, difference contracts or *swaps*) are reckoned to allow investors to hedge against long-term risk when they invest in peak and base-load equipment. Covering the majority of transactions by future contracts would at the same time remove the incentive to manipulate spot prices and increase their volatility, especially during peak and extreme peak periods (Newbery, 1998). In fact, it must be noted that the standard tools for managing trading and risk (options, etc) are not suitable for dealing comprehensively with the price-risk on the electricity market. The demonstration of that is given by the bankruptcy of the pure traders which had entered the market in the eve of reforms in the USA. Moreover, the peculiar market volatility create a sound difficulty in reading price trends for deciding installation of new units and for hedging investment. Likewise, they are not able to offer risk coverage for the depreciation period for the electrical equipment to be installed – at least 10 years. The maximum duration of these option contracts is three years.

Concerning the treatment of capacity adequacy as a private good by an insurance system, there have been in many places progresses to create elasticity of the instant demand by different type of contracts with the consumers. But there are still important barriers to generalise the approach. It needs a generalisation of the deployment of metering control and information technology to allow curtailment of load and direct response of customers.

[3] It will be noted that in practice, up until now the effects of these programmes in the American States or in Great Britain have been very limited.

Secundly that needs also that customers must be exposed to real time prices, which. Thirdly that would need a very complex system of contracts difficult to manage by the crowd of mean and small customers because of the transaction costs, that are systematically forgotten by the proponents of the pure market model.

2. Improving the incentives to invest in mature electrical industries

The main way in which the question of shortcomings in investment incentives is dealt within mature electrical industries is the adaptation of market rules around the issue of the supply of peak power. Any decentralised decision to invest *de facto* has an external effect by leading to the preservation of the reliability in the long run. This assurance is supplied through investments by various decentralised producers through peak equipment as well as for base load production. This is what constitutes the collective good of the "capacity adequacy".

It has been said that the technical reliability is analysed as a public good the supply of which is ensured by the transmission system operator who has the technical authority required for control of real-time adjustments of the production of decentralised actors[4]. In this perspective, it will be logic to complement the offer of this public good by new incentives to guarantee it in the long run by adding incentives to invest for guaranteeing "capacity adequation" in peak. That means that "capacity adequation", which depends on the investment decisions made by the decentralised actors, has to be considered as a complementary public good of the "reliability". The position of considering "capacity adequation" as a public good is contested by the defenders of the pure market incentives. They considered that it could be treated in a logic of insurance market as a private good by allowing customers to choose the level of protection they desire in the direction lighted up just above (Stoft, 2002; Oren, 2003). That implies an increased complexity of transactions with new financial products, with new uncertainties and larger transaction costs for the market players.

It will be noted that the stake of development of base-load capacities is subordinated to this question, given that resolving the first question by creating incentive to develop these peak capacities contributes also to consolidate incentives for the base-load equipment. The investment of electricity production in a base or semi-base load equipment does not lead only to the production and exchange of energy between a producer and its future clients, but also to reliability on the long run, that is, "capacity adequacy" and assurance of supply in peaks and extreme peaks. It will be noted also that the problem must be widened in mature industries to include decentralised decisions to close equipment; these decisions have a decisional horizon and response time must shorter than the creation of new equipment. They can have a very significant effect on capacity adequacy and must be integrated into a long-term co-ordination, something that is not yet being seriously envisaged anywhere (Turvey, 2002).

In view of the high value of the reliability as a collective good produced by the adequacy of capacity during peak periods in the long-term, the onus is on the regulator commissioned by all the agents to preserve that collective good. Several directions must be explored: the use of instruments of public economics for the offer of public good, the setting-up of long-term co-

[4] The need of this public good justifies the technical authority of the network manager over the producers for hourly adjustments. It justifies also technical specifications imposed on producers and systems operators in terms of maximum variation of frequency, voltage and phase difference, and on suppliers in terms of minimum capacity reserves that they would have to contract (see below).

ordination, the acceptance by the regulator of quasi-vertical relations with regard to long-term contracts or to integration between production and supply, and the tolerance of horizontal integration and loose entente on spot price between dominant producers .

We will present advantages and limits of these five solutions: the three types of public governance for ensuring capacity adequacy at peak times and two solutions of private governances. Referring to the efficiency of the market instruments inspired by the Public Economics concerning instruments to promote the supply of a public good, we will use the categorisation by Robert Wilson (1999) of the tariff solutions for network access (losses and congestion) in Pigouvian and Coasian solutions. Then, referring to the transaction cost theory which is another valuable base of the antitrust doctrines (Joskow, 1995), we consider the public governance solution by centralized procurement of new capacities in view of capacity adequacy, then we analyse three private governance solutions: long-term contracts, vertical integration and entente between dominant producers.

2.1. The Pigouvian solution: adding a term of capacity to the hourly spot price

The Pigouvian solution consists of adding an capacity payment to the marginal price of the energy which is the hourly price defined on the spot market. This term is reckoned to reflect the value of the marginal utility of the supply available at peak times, that is, the value of the social marginal cost of the supply failure. It would the value given by a fictitious market where power supply and demand would interact normally during peaks and super-peaks, if the willingness of consumers to pay for security of supply shows itself in additional payments for supply or withdrawals if they consider prices too high.

This market rule has three functions:

- first, to encourage producers to declare their available capacities at peak times, as in the logic being sought they should be paid for declaring themselves as such even if not called by the market administrator ;
- second, to encourage investment in peak units and non-decommissioning of old units ;
- and third, to ensure additional income for the new equipment intended for base or semi-base load production, while at the same time contributing to the peak.

This last concern, that of making the base-load equipment profitable, certainly exists even though main and direct justification is the need for capacity adequacy at peak times. It is more pronounced in developing countries, especially in those where the regulatory risk is higher and/or the markets are subject to significant price uncertainty because of particular technological constraints, especially the unknown factors in current hydroelectric production (Newbery, 2000).

There are two methods to define the capacity payment. In the first method, formerly followed in Great Britain, the regulator chooses to define a fictitious value for the failure following a survey of purchasers. He then chooses to carry out a sophisticated *ex post* calculation based on the product of the VOLL (Value of the Loss of Load) and the probability of failure evaluated *ex post* according to the hourly supply-and-demand difference, using a mathematical model. In the second method, more in line with a simplified approach of the Pigouvian perspective on the social cost, it is possible to confine oneself to a cost-efficiency process in which the marginal profit is not known. The value of the capacity term is defined

according to the cost of the peak marginal unit (investment and fuel), which is divided across the number of hours for which the overall power offered by the system should be guaranteed. This simple solution, adopted in Spain, avoids the need to manipulate the rules, in contrast to the more complex solutions in which the value is calculated *ex post* according to the probability of failure evaluated with a model of the electrical system.

This solution, however, only applies to the obligatory "pool" type markets (Spain, Britain before 2001, PJM in the USA, Argentina); it has to relate to all physical transactions as they all contribute to the guarantee of supply.

The criticism of the capacity payment by the proponents of pure market mechanisms highlighted three aspects (IEA, 1998 and 2003; Oren, 2003). First they observe that it tends to give supplementary revenues to dominant producers without offering a sufficient insurance against price-risk to the other competitors and the entrants. Second, it does not encourage the development of demand withdrawal programmes. Third, it would encourage excess investment in peaks. To these critics we must add the difficulty raised by the risk of gaming with rules: the British market design offered an opportunity to manipulate the rules which has been widely analysed. The reform of the UK electrical market in 2001 abolished this market price element.

2.2. The Coasian solution: exchangeable reserve obligations

It is known that the market cannot reveal easily the clients' willingness to pay for avoiding supply interruptions and price volatility. It is therefore decided to make the suppliers responsible in relation to their *ex-ante* capacity to satisfy extreme peak demand of their customers in real time[5]. An obligation of reserve capacity is imposed, defined in relation to their peak sales in the last year with a reserve coefficient added[6]. In theoretical terms this led to the creation of property rights over the public good of capacity adequation and allow the possibility of these rights being exchanged, here on a so-called "capacity market", for an efficient reallocation of reserve obligation.

A market is created in order for the agents to find a new source of revenue if, during the extreme peak, they have an available capacity higher than that to which they committed themselves to hold by referring the previous year, especially because of uncertainty of outlets. This system is deemed sufficient for providing an optimal capacity level and avoiding the supply interruption costs and price peaks. This device could be considered as optimal as the commitment is complemented by the rights exchange on the "capacity market", which is added to the market architecture, because it allows the equalisation of marginal costs of respect of their respective obligation by the suppliers (Besser et al., 2002; Hunt, 2002). In addition, a penalty system is introduced with two functions: first to encourage suppliers to respect their commitment and to look for additional rights in the event of an individual reserve capacity deficit in relation to it.; second the penalty incurred constitutes *de facto* the price ceiling on the "capacity" market.

[5] In a series of experiments in the USA (especially on the PJM market and the New York State market), it was the "load servicing entities" who have to find by their own permanent balancing between their sales and purchases and who voluntarily undertook to find the required peak capacities, which were defined precisely with the system operator. The status of "last resort supplier" or "default supplier", and the status of "load servicng entities" were assumed to lead to a sufficient overall commitment through the addition of capacities guaranteed by these various entities.

[6] A coefficient of 12%, for example, is included in the proposals for the capacity obligation called the ICAP for the Standard Market Design defined in 2002 by the US federal regulatory authority, the FERC, for reforming the already deregulated regional US markets.

This device is congruent with the market regime, because the suppliers who have not a stable perimeter of outlets because of customers' switchings, have a mean to enforce their capacity commitment. The capacity market allows them to buy some lacking rights if their capacity portofolio or contractual purchase have changed since the last year. But this system presents two main difficulties. Firstly, the duration of the commitment must be relevant in comparison to the lifetime of the production assets to be developed in order to respect the rights. It is in fact impossible to impose long-term commitment on suppliers, that will reduce the incentive to incest in peaks. Secondly, in cases of integration of regional markets, the producer-suppliers may neglect the local capacity market if they can sell energy on neighbouring capacity markets during peaks when these markets pay better (Creti and Fabra, 2003). Thirdly the definition of the level of reserve obligation by the regulator is delicate in the sense that the marginal utility of the reliability in peak period must be known[7].

To sum up, these two solutions are courses of action that are difficult to implement. The first is only valid for obligatory markets (which are becoming less and less in number). The second means that the market architecture must be made much more complex and is difficult to implement for a regional market with good technical and institutional communications with other ones. A third public solution considers that the onus is on the public authority to offer this collective good directly through long-term co-ordination.

2.3. The offer of "capacity adequacy" by centralized procurement

The institutional device of centralized procurement can deal only with the adequacy of the power capacity in peak, or can deal jointly with peak power and annual energy, i.e. the base load and semi-base load capacity. The rationale of this wider coverage could be twofold: the capacity adequacy and the energy sustainability as a public good: the latter implies that the government seeks to orient the technical choice of the investors in generation for limiting the energy dependence and the environmental impact of the electricity production. But it is noticeable that the focus is generally on the capacity adequacy for the peak power demand.

In borrowing from the transaction cost theory, which looks to explain the selection of institutional arrangements while considering complexity, uncertainty, asset specificities and the problems of measuring transactions, we refer to the pioneering work of Joskow and Schmalensee on electrical reform models (1983). Overall, this work provides the clearest theoretical views on the weakness of incentives to invest in complex and volatile electricity markets and the responses to be made to those weaknesses. In their comparison of several hypothetical models, they conclude that the adoption of the de-integrated competition model with decentralised agents and complete separation of network and organised spot market, presents the most difficulties in relation to investment decisions[8] (pp.173-190). They propose two developments for limiting these drawbacks : first the introduction of co-ordination structures for developing production and network capacities, second the possibility for the

[7] A fourth difficulty lays on the feasibility of a provision to enforce the incentives to respect the reserve capacity obligation. This system may be complemented by the threat of non-supply by the system operator in the event of failure to honour capacity guarantee commitment (remenber that the respect of the obligation in extreme peak will be controlled by the system operator). But this threat can only be carried into execution towards a seller who legally preserves a significant captive market, like distributors in cases of partial market opening, because if his customer base is dispersed between different cities or geographic areas, the individuation of the physical flows to this supplier is impossible

[8] Together with these faults, they mention loss of co-ordination economies and increase transaction costs. They stress that the compensating gains to be expected are connected in the long term with the incentive to invest adequately and to choose techniques less costly than those in place by mobilising technical innovations.

market operator to contract on the long run as the implicit distributors' agent, third the allowance long-term arrangements between producers and purchasers.

Faced with the need to guarantee long-term capacity adequacy, we could put forward the principle of an administered method to guarantee that sufficient investment is provided to ensure it. This governance structure has two functions: it must ensure regular co-ordination of anticipations of competing agents for informational purposes, and must be able to decide on organising the development of capacity by auctioning for long-term contracts in cases of anticipated deficit, in its capacity as responsible of the reliability in the long term.

Box 1.
The need of a public governance for transmission investment

We must notice rapidly that the same applies to the need for a governing structure to ensure long-term co-ordination for the development of network capacities[9]. From a theoretical interpretation, decisions to invest in a networks cannot be based on the "invisible hand" of the market because of the intrinsic incompleteness of property rights in this activity (with loop flows and externalities), the form of the cost functions (very high fixed cost and scaled economies), and the imperfect nature of competition in production that could lead to either under-investment or over-investment in different parts of the system without consideration of the congestion (Joskow, 2002).

The abundant literature on optimal transport pricing methods is concentrated on variable costs (allocation of losses and congestion costs) meanwhile the fixed cost (80% of the total transmission cost) are a matter of quasi-uniform sharing on the locational transmission price. So the market signals produced by the various available transport pricing methods appear inefficient for orienting the investment in strengthening the lines and optimising them on a local basis. Organised programming between the system operator and the regulator is therefore the inevitable solution.

Moreover a more specific coordination for the development of interconnexions capacities between the transmission system operators of different countries or internal regions is a complementary way to answer to the need of peak capacity adequacy, in particular if the respective electricity systems presents heterogeneities and so useful complementarities.

The function of this device is generally envisaged around the capacity in peak. But we have seen changes in European reforms on the issue of production capacity development in base-load as in peak power supply, especially since the Californian market crisis. During the discussions held in 2001-02 on the second European Directive on electricity markets, voted in June 2003 and aimed at increasing the scope of the reforms, an article was added that allowed the States to organise systems in that direction in the name of security of long-term supplies. (The French legislation voted in February 2000 already includes this provision[10]).

Whatever the focus is put upon (peak capacity or energy capacity), this structure of public governance gives the electricity regulator or competent ministry a double function:

[9] The problem of incentive to invest in transportation and distribution networks is every bit as crucial as the problem of investment in production. The networks must allow unrestrained access for producers and purchasers in order to allow a market to function in an effective way (Joskow, 1996). The ideal situation for this to happen is transmission overcapacity without congestion on the system and interconnections, that allows the relative unpredictability of changes in merchant flows to be faced during the former period of the monopoly in which networks have been developed in a strictly anticipated and co-ordinated way.

[10] The French legislation of 2000 granted the ministerial authority the task of providing a regular forecast of growth in demand and of co-ordinating the anticipated demand for new capacities in the context of an official programme ("Programmation Pluri-annuelle des Investissements" or PPI). This task was combined with the legal possibility of auctioning for the long-term contracts. The only restriction was that the type of equipment would be stipulated and justifiable under national requirements.

- Indicative programming for development of production capacities and networks.
- Auctioning for the awarding of long-term sales contracts at guaranteed prices.

In a context of a total opening up of the retail market, these contracts have to be signed between investors and main suppliers, who were subjected to an obligation to purchase in proportion to their outlets. This method of dividing purchase obligations between competing suppliers makes them bear an identical unit charge for each kWh sold.

- *The limits of the public procurement*

Generally speaking, the system of auctioning is open to criticism for three complementary reasons:

- First, it limits the scope of the markets of bilateral contracts and of spot transactions by contravening the principles of competition and forcing entry by producers at guaranteed prices. So it tends to distorts the wholesales prices in peak period (if auctioning is only in peak) or in all year long (if auctioning is on peak and base-load equipment).
- Then it creates incentives to free-riding. Market players ready to invest in peak (and base-load) equipment will be dissuaded from investing because of the outlet and price risks that they have to take on, preferring instead to save themselves for responses to the invitation to tender. That means that the system will tend to self-reproduce.
- Finally, because the electricity markets communicate with each other, it is difficult to justify auctioning, which is based on a postulate of autarky as the programming operates on a closed national territory hypothesis for assessing the need of new capacity in peak.

Coming back to the issue of the price distortion with auctioning for peak capacity, there is never any complete guarantee that the programming will be properly adjusted and investments encouraged by this system suitably adapted or effective.. In fact, the planner or the regulator cannot anticipate everything; programming peak investments remains a random process. Peak equipment will arrive too late if the procedure is not started after a crisis, or may arrive too early and in too great a quantity. In this case, the market during peaks and extreme peaks will be depressed. That means that the peak prices could be depressed after the realisation of auctioned investment with two consequences : to pledge normal investment in peak capacity, but also to limit the prospects of value extraction during peak periods for the candidates to invest in base-load equipments (Bouttes & Trochet, 2002). The result will be a shortfall of base-load investments, and this could lead to long-term price peaks and possible hardship, unless the procedure is widened to base-load equipment with the problems mentioned above.

Some of these points can be answered. First, despite the potential for national market integration, the search for capacity adequacy during peak periods, seen as a collective good, would justify this kind of approach politically, given that restriction on interconnection capacities between systems during peaks can be anticipated. Second, because of the reduction of outlet and price risks that this system would provide to investors, prices offered in the responses to the invitation to tender would be lower than the prices sought by the producers who invest in a volatile market; this could be favourable for consumers. But that means also that the system should have to know a reversal to the former public coordination of investment with the regulated monopolies.

Anyway the implementation of such a system could in fact only be justifiable politically on grounds of peak capacity requirements, because of the sensitive nature of price peaks and power shortage in terms of acceptability of reforms. Away from this justification, the organisation of auctions for base and semi-base equipment will be too antinomic of the competition principles that will remain the basis for the reforms, unless this way of public governance has another basis. This could be, for example, the preservation of a collective good (the climate stability) by the promotion of renewable energy sources in relation to reducing the greenhouse effect, or, in some countries such as France, the aim of limiting long-term energy dependency by the promotion of a particular technology such as nuclear plants to get an equilibrated technology mix.

The system of *competitive bidding* is therefore difficult to justify in totality, as implementing it encounters several problems. It must be pointed out that some have mentioned a fourth solution to the problem of incentives to invest in peak equipment : application of bonus points to rates on the loans taken out to finance this equipment (Oren, 1998).

2.4. The need for long-term contractual arrangements

The approach in terms of transaction cost theory (Williamson, 1985) reveals that complexity, uncertainties, frequency of transactions (which would be necessary in order to organise the outlets for the production of a new equipment, and to insure the recovery of the investment and its profitability) justify the choice of long-term contracts or the recourse of form of vertical integration to avoid the "hold-up" on new investment. The degree of specificities of assets to the transaction which is the main factor to explain the choice of a type of institutional arrangements between sales on the spot market, contracts and vertical integration is a secondary factor here.

The libertarian precepts of anti-trust doctrines recommend radical vertical and horizontal de-integration in electricity production and supply, and forbid the signature of long-term contracts, following theoretical work on long-term contracts as barriers to entry (see most notably Aghion & Bolton, 1986). In the "neo-institutional" critics of this position, Joskow and Schmalensee, confronted with the uncertainty of outlets and short-term prices on wholesale markets, have been asserting since 1983 that operators will look spontaneously for institutional arrangements that allow them to invest without risking the active or passive opportunism of purchasers in relation to long-term contracts or integration of production and supply[11]. Since the implementation of the reforms, developments have proved them right.

In fact, in a competition-based market with decentralised market, the bilateral contracts with a maximum duration of two or three years, which have become the rule with the coming of the optional electricity exchanges, are too short. In addition, they do not guard against price risks as the prices of the producers' sales contracts with distributors, suppliers or large consumers are indexed on the electricity exchange price. Meanwhile spot price movements are very little readable for drawing market trends, in particular the long run trends showing the need of new capacities. Guarantees are therefore needed for investment in production, through long-term contracts that limit the outlet risk through "take or pay" clauses and limit the price risk through guaranteed price clauses independent of the spot price, with a fixed term so as to guarantee recovery of capital costs. The protection of the purchaser has also to be given by a clause of penalty in case of producer's delivery failure.

[11] They referred to the experience of the independent production contracts signed between entrants and utilities with a monopoly of supply, which at the time were developing in the USA.

The case of the investments made in production in the United Kingdom between 1990 and 2000 show that it was through recourse to these long-term arrangements that the situation was able to progress. After 1990, despite the principle of non-integration of producers and suppliers-distributors that it advocated, the regulator authorised them, because it was anxious that the initial production assets were initially dispersed amongst too few producers. Also, the regulator has authorised the signature of bilateral 15-year forward contracts (as they are forward, the prices are more or less independent of the spot price) between distributors and production entrants that were themselves minority subsidiaries of the former. This organisation was enforced by the distributors' detention of a regulated captive market to which the overcosts could be passed through. About 15 GW of gas-combined cycle units were thus put built in this context, despite the initial overcapacity (Newbery, 2001). Contrarily, the entrants through investments made without contracts only after 1999, the so-called "merchant plants" mentioned earlier, suffered failure, because they have not a downstream supply activities to support the consequences of the market rules changes in 2001 in a context of overcapacity.

This "transaction cost" justification for long-term contracts is found in more conventional analyses that conclude there is a need to circumvent the principles that see long-term contracts as a bar to the development of competition. Newbery (1998, 2000) thus defends the interest of long-term contracts for entries through the installation of new equipment. The main thrust of his proposal is disconnection between contractual price and spot market price in order to guarantee recovery of capital costs. However, as the "transaction cost" analysis points on opportunistic behaviour in this type of configuration, this contractual system is only stable if the purchaser is dissuaded from arbitraging between the quantities to be carried off under its contract and those that it would purchase on the spot were there significant differences between the contractual price and the spot price, and vice versa for the producer towards the purchaser.

There is therefore a real difficulty with this proposal, because of the foreseeable price difference between spot sales on exchanges and bilateral contracts, which is likely to encourage opportunist behaviour from purchasers when the spot market prices are geared downwards for a long period, and vice versa. To get round this problem, the purchasers must be able to recover all their wholesale electricity purchase costs on their sales prices, and this can only be envisaged with distributors who legally preserve a significant captive sector[12].

2.4. The incentive to vertical integration of production and supply

The specific reality in the electricity markets makes also it look logical to allow or to maintain the vertical integration of production and supply, as the long term contractualisation is not always easy to implement. It is seen in most European countries in which thinking on competition is less determined by standard market theory, and in which reformers and regulators have more or less consciously chosen to reduce the problem of future investment.

[12] In this same logic, it will be noted that in 2001, countries confronted with the collapse of their electrical markets, such as California, adopted investment incentive frameworks that responded to a principle of purchases guaranteed at a stabilised price. In both of these cases, a specially created public agency negotiated a number of long-term contracts with investment applicants. The electricity under the contracts was subsequently purchased as a matter of priority by the major suppliers and distributors. The Californian contracts, negotiated during the crisis period at $90/MWh, were at relatively low prices, at a time when crisis prices of $200 or $300 $/MWh were very much higher in relation to the normal wholesale prices of $20-30/MWh. A lengthy re-negotiation procedure has been started.

They have not looked to bring about separation in production and supply in the name of effective competition as in some countries. The industrial structures, especially vertical integration between production and sales, have not been touched in Belgium, France, Germany, Spain or Sweden (see table). In France, in addition of auctioning possibilities, there has been specific defence of the possibility of reinvestment in new nuclear power units, with strong vertical and horizontal integration maintained. Great Britain, Norway and Italy have been the only countries to take any significant de-integration measures. Recent changes in Britain have also shown that in order to guard against the risk of price volatility after the introduction of decentralised market with much less certain prices, the regulator allowed a double vertical integration movement from producers towards sales and from suppliers towards production, while the independent producers without sales bases were eliminated, with the bankrupt of the merchant plants. The portion of transactions that arose from self-dealing on the British electricity market is therefore estimated at around 75%. The adoption of this form of production-sales vertical integration will make it easier to invest in production in future, thanks to the sales bases that the electricity companies hold downstream and the relative control of the risks that they insure.

Table 1. Vertical and horizontal integration of European electricity industries (2002)

	Concentration in Production	**Concentration in Supply (C3)**	**Integration Production-Supply**
England-Wales	< 50% (C_2)	37%	(Integration restricted on 1990-99) >80%
Norway	< 50% (C_2)	40%	>50%
Sweden	70% (C_2)	52%	>60%
Spain	75% (C_2)	94%	>85%
Germany	70% (C_2)	62%	>70%
Netherlands	< 50% (C_2)	80%	20%
Belgium	> 95% (C_1)	85% (C1)	85%
Italy	75% (C_1)	93%	(Integration restricted) vers 70%
France	90% (C_1)	96% (C1)	90%

Sources : European Commission (2002*) Second Benchmarking report.*
Indicators - C1 : Share for the top 1, C2 : Share for the top 2 , C3: Share of the top 3

2.5. Tolerance for the oligopolistic control of the wholesale markets

The recent horizontal concentration movement that can be seen in some countries (Spain, Sweden, Finland, Austria and especially Germany since 2000) has to do with this classic response by the market to a risk situation: this corporate strategy answers to the logic of market share maximisation and the limitation of risk in view of commitment in large investment in the future by controlling the market. In France and in Belgium the defence of a

strong horizontal integration is clearly linked to the will to preserve the capability to invest in highly capital intensive equipment.

We could conceptualise the political economy of this type of arrangement. A club of large actors inside a country or between several integrated markets may firstly seek to stabilise prices at a higher average level than the competitive solution. However, such a club would also have an interest in stabilising the system price performance within the social acceptance space, knowing that excessive price spikes might call for regulatory intervention. The club could therefore be motivated to supply necessary capacity to secure smooth performance and, due to a tacit entente, it would not have to take the competitive market effects of some over-capacity with low prices after uncoordinated investment. An implicit agreement with policy makers or society would then be not to push the price too high, in return for which government would not press for stronger regulatory antitrust intervention to break collusion.

In summary, there is no perfect solutions to the issue of incentives to invest in the volatile new electricity markets in North countries. With their mature markets, the degree of pressures to invest being quite low, a number of corrective solutions of the pure market model of decentralised competitive players could be envisaged to enforce the incentives to invest. The main explicit amendment is the various treatments of the peak power "capacity adequacy" as a public good because there is a political legitimacy to do it without turning the back to the competitive model. So it is for the addition of a capacity payment for the kWh in peak period, for the instauration of exchangeable obligations of reserve capacity and for the use of centralized procurement by auctioning for peak capacity, with some drawbacks in terms of increased complexity of market rules, reduction of the competition field and price distortion. More important are these distortions when the public governance structures are enlarged to the coordination of every investment by a provision which extends the possibility to auction for base-load equipment.

Table 2 : Comparison of public coordination in view of the capacity adequation during peak

	Price-instrument	**Quantity-instrument**	**Public procurement**
Institutional device	Capacity term	Peak capacity contracts obligations on supplier Penalty Flexibility mechanism(capacity market)	Programming and bidding Long term contracts Mandated purchase
Theoretical hypothesis	Equalisation of marginal disutility and marginal cost of availability	Definition of quotas de capacité de réserve en fonction de la désutilité de la défaillance	Benevolent regulator Anticipation parfaite du besoin de puissance de pointe et de réserve
Limits	Risk of overestimation of the disutility (effect of peak overcapacity)	Risk of regulator's overestimation of the reserve ratio	Risk of Overestimation of the peak needs (with depressing price effects) Free-riding
Applications	Spain, Argentina, England-Wales (pre-2001)	US regional Markets US (PJM, New York, New England)	

The observation of reforms suggests also the development of some solutions based on a limitation of the competition by regulatory allowance for long term contracts and vertical integration between production and supply. The transaction cost theory gives a justification of the recourse to these alternative institutional arrangements, but the stability of long term contracts is far to be a priori guaranteed beside the cyclical move of spot market.

Finally observation suggests the implicit choice to tolerate horizontal integration and market power exercise as a mean to prevent shortage by making price higher than the level reached by effective competition and reaching the profitability level for investing by this way. It is an approach which is radically in opposition with the canonical approach of the competition and has no rationale in theories influencing alternative anti-trust doctrines. So there is no other justification to it than contextual : if the dominant producers understand that their well-conceived interests are to self-limit the exercise of their market power, they could maintain the political and regulatory tolerance of their oligopolistic control of the market.

Are these different solutions valuable in other contexts than mature markets and institutional environment allowing political compromise around reduction of the field of competition and a self-limitation of the use of market power ?

3. The need of specific approaches for Developing Countries

In developing countries, the electricity reforms imposed by the international financial donors were aimed first and foremost at getting round the problem of financing investments against a background of the chronic debt crisis. The main aim was to attract private capital in order to finance new investments, with the obvious associated aim of improving performance in the sector. However, for these electricity systems which grow quickly and at an irregular pace, the paradox of these reforms is that the constraints of long-term investments are too frequently overlooked by the reformers and their consultants. Here, more than in Northern countries, the market signals from the competition model are not sufficient.

Despite the variety of the economic situation of the developing and emerging countries, the question of reliability and capacity adequacy in peaks or extreme peaks, which as we have just seen is the main point of entry in the problem of investment incentives in Northern countries, disappears completely in the light of the more general stake in investment in production of annual electrical energy. We will demonstrate that institutional framework of long-term contractual arrangements under the aegis of the public authorities, which will retain a planning function, must be included in the *design* of the reforms.

3.1. The unsuitability of the competition-based model for investment

A major difference between most South countries and the North countries is the weakness of the institutional framework in which private investments can be deployed in a competition-based context. It is important for the legislative and regulatory framework to be clear and to offer protection against discretionary intervention by the public authorities or by the regulator, for credible arbitration procedures to be recognised, and for competition law to be able to regulate the market players' game.

Beyond the huge variety in levels of development, market sizes, growth rates, maturity of network infrastructures and resources available for electricity production, developing countries have been the subject of similar recommendations under the same market paradigm (for a synthesis, see Bacon & Besant-Jones, 2001) [13]. The "reform" involves building up institutional credibility in order to attract private operators, by de-integrating the sector with separation of distribution, privatising the production companies through transfer of assets, introducing network access rules and constructing a unified wholesale market beside the bilateral transactions producers-distributors. The aim of privatisation and competition is to create incentives to efficiency of management, especially by adjusting prices that are too far removed from costs, by reducing non-technical losses and non-payments in distribution, and by putting up barriers to discretionary intervention by the public authority.

In brief, the aim is to end up with a model similar to the British model to bring in investors. Some small Latin American countries (Colombia, Bolivia, Ecuador and some Central American states) have adopted it without too much insight behind Argentina and Chile (Millan, Lora & Micco, 2001; Fischer & Serra, 2000; Weinman, 2002). Brazil followed suit later because of the difficulty in designing a market with a very high level of hydroelectric production and externalities of units operation of the same basins before encountering the limitations of the market model immediately in 2001 during the first drought period.

This scheme is always underlain by the idea that the hourly prices defined by the confrontation between instant supply and demand on an organised market are the only ones that optimally show the scarcity of capacity to meet peak power demand as well as annual energy demand. However, in the light of the difficulty posed by the actual institutional situation in these countries, it has been agreed that the reform can be instituted in stages in order to allow the institutional environment in the sector to be altered and performance levels improved, while achieving the objective of developing new capacities during this transition (Bacon, 1995; Bacon & Besant-Jones, 2001; Millan et al, 2001).

One passes through the initial "single buyer" stage, in which the former integrated public company conserves its wholesale monopoly towards the distributors, who are themselves in a sales monopoly situation. The South and South-East Asian countries (Malaysia, Thailand, Indonesia, The Philippines and India), which unlike the Latin American countries have shown great reluctance to adopt the competition-based model, have remained with the single buyer model and reforms in the public company and in distribution. That having been said, in the eyes of the international donors and their advisers, this stage is only a temporary phase before the transition to the decentralised, competition-based, privatised model that will be the only one able to produce the proper market signals for investments by private operators. However, is the competition-based model really conducive to the move towards development of investments? Because if the institutional credibility is improved as a result, this model will not reduce the economic risk of the investment.

3.1.1 Investments and competition-based models

We have previously seen the difficulty posed by the realisation of production investments in the context of liberalised organisation of mature industries. Most European countries have been able to overlook the stake because, when they get round to reforming the electricity industry, their electrical industries was in a situation of overcapacity. At present, in the same

[13] This article provides a synthesis of the position of the Industry and Energy Department of the World Bank, expressed in particular in the information note *Private Sector* and the note *ViewPoint*.

industries, there is a need to correct the market design by not fundamentally questioning the competition-based regulation of the sector. We have seen that the new market rules centred solely on peak "capacity adequacy" are not necessarily up to the challenge and that it has been difficult to point out any optimal institutional device or an industrial organisation that guarantees the capacity developments without moving too far away from competition-based principles. In South countries the problem of electric generation investment in competitive environment is increased by the character irregular but potentially rapid of the demand. The degree of uncertainty and investment risk is strengthened by the predominance of hydroelectric power in many electricity systems in South countries, especially in Latin America and South-East Asia, where there is still large potential for hydroelectric resources to be developed.

It must first be pointed out that the experiences capable of proving the argument that the de-integrated competition-based models is conducive to investment in production in South countries are limited. Let us refer to the few electricity industries deregulated according to this model which are all located in Latin America.

- In Chile, the investments made were made in the context of vertical integration of production and supply in a model of industrial organisation with very limited opening to competition on the final market: the distributors keep a significant captive sector that allowed them to bear a higher risk to invest in generation.
- In Argentina, the problem of investment was never a really pressing one, as the 1992 deregulation coincided with the commissioning of large amounts of hydroelectric equipment that suddenly increased the Argentine electricity systems' capacity greatly; the 18 TWh of available production at Yacyreta, when commissioned, corresponded to 30% of total production. The equipment installed since the reform (3,500 MW between 1992 and 1999) consists mostly of gas turbines developed in the context of long-term contracts with distributors who have kept a significant captive sector and benefit for most of the projects from gas purchase contracts that transfer all the electricity price risk onto the purchase price of the gas (Hasson, 1998)[14]. Since that period, any generation investment has been set, that provokes shortage in 2004.
- In Colombia, which adopted the centralised pool model, developments in capacity have been made on the basis of *power purchase agreements* signed before the reforms and transferred to the distributors.
- Finally, in Brazil, between the preparation of the deregulated framework in 1995 and the 2001 crisis, investment was strongly discouraged because of the uncertainty over the future regulatory framework and suffered the eviction effect of the use of private operators' financial resources through the purchase of distribution companies, which was considered more profitable than investing in production (Pinto, 2001; Araujo, 2002).

3.1.2 The need for market imperfection in order to encourage investment?

[14] To be more precise, we add that the Argentine distributors are subject to a 30% regulatory constraint on vertical production integration. However, other vertical integration links have been created by some acquisitions which give vertical control between the various levels of the electricity industry. Finally, it should be added that the Argentinian wholesale market is not based on auctions on the basis of prices declared hour by hour, but on the basis of annual declarations of variable costs and day-ahead notification of availability for each unit ; this limits largely the volatility of the wholesale markets. Note that since 1996, no new project has been undertaken because of the serious macroeconomic uncertainty in the country.

Some people have explicitly proposed playing on the shortcomings of the competition-based model in order to answer the requirements of long-term investment. A good example of this approach is that of the Inter-American Bank specialists mentioned above (Millan, Lora &t Micco, 2001), who twisted the standard principles to a considerable extent in the name of the need to develop capacities. They put forward three solutions.

- First, they considered that in the systems reformed on the basis of a de-integrated model of the British type, the exercising of market power by a small number of producers should not be criticised in the last analysis, because by producing higher prices it allowed the attraction of entries and therefore stimulated the development of new capacities (op. cit., p. 33). The exercising of market power in a period of capacity-related tension is therefore welcome, as the entries that it produces will allow scarcities to be reduced and even the problem of concentration to be lessened. The objection will be raised that the efficiency of this way, based on market imperfection, cannot be demonstrated for two reasons: the caustiousness of investors confronted with the volatility of the markets, and the unavoidable problem of social acceptability of price peaks as an incentive to investment.

- Next, they consider (and this is similar to the observation made above about the need to accept arrangements that fly in the face of the standard competition-based model), that on a market with a specifically high price volatility, investors must embark on long-term contracts that move the risk onto other market participants, the distributors or the large consumers. This is the solution put forward by D. Newbery (2001), who argues that the risk of interruption to supply and the increased volatility of market prices create incentives amongst some categories of actors who want stability of supply and guaranteed prices to sign long-term contracts with prices disconnected from the spot market prices, or to construct and operate their own electricity-producing equipment. In fact, there are several major electricity purchasers within the electricity-intensive industries who have proceeded in this way in some countries, or have developed their own capacity by selling their surpluses to the network. This method, which incidentally is a return to one of the development paths followed by some electricity industries (Scandinavia, some Alpine countries, Canadian provinces) in the late 19^{th} and early 20^{th} centuries, must however be a secondary route only. From the purchasers' point of view, in fact, few consumers will be interested in involving themselves in this vertical integration solution.

- Finally, they call for a transparent and stable institutional environment for enforcing IPP contracts but they consider that if it is not produced, one can, as a last resort, make the best of the institutional weakness. The possibility of capture of the public authorities (government or regulator) by industrial interests could in itself be an investment-conducive environment.

As seen before in the case of the European reforms, the twisting with the basic principles behind the competition reforms for helping investment are not the monopoly of the reformers in the South countries. But there is much less guarantee that it avoids large inefficiencies because of the absence of self-control mechanisms that exist in the European countries because of existing institutional equilibria (see above). So, in the case of developing or emerging countries, when faced with this theoretical twisting, one should in fact reverse the process of thinking. It appears much more logical to design reforms around the need to enforce commitments in investments by creating public governance by long-term co-ordination and reduction of investment-related risk through long-term contracts. Complementary measures to give credibility to the commitments of the "single buyer" must deal with a radical correction of the public monopoly model by an industrial organisation less

concentrated than the previous integrated public monopolies, so that the public authorities can be kept at a distance and incentives to efficiency introduced. In this organisation, the function of the competition-based exchange, if it is introduced, must be kept on the edge of the industrial organisation for simple short-term adjustments, without the spot prices becoming the driving force behind the contracts.

Faced with the foreseeable repeated failure of the competition-based model when faced with the capacity development stakes, there will probably be a return to principles similar to those of the single buyer, with priority given long-term contractual agreements. This is the case with the system defined in Brazil in 2003 following the serious crisis of 2001, which can be explained in part by lack of investment. But the model of the single buyer and long-term contracting is full of pitfalls with shortcomings which have to be carefully balanced with the advantages, in order to meet the challenge of new capacity development.

3.2. Advantages and shortcomings of long-term co-ordination systems

The “single buyer” device is integrated into an industrial organisation where the “single buyer” entity holds the monopoly of wholesale over the distributors and sometimes over the major consumers. This was the first model to be applied in developing countries with the aim of getting round the restrictions on financing public electricity companies against the general background of debt crisis.

- The governments authorise private businesses to invest in order to produce and sell electricity in the context of long-term contracts signed with the “single buyer” business.
- The public authority (ministries) organise programming of capacity development. When the need of new capacities is identified at mid –term, the entries occur following an invitation to tender and the applicants’ entry into competition in independent production.
- These “power purchase agreements” (PPA), -- which will allow funds to be obtained from lenders to finance most of the investment through “project financing” (that is, outside the scope of the balance sheet) -- are generally drawn up with risk sharing clauses and capital profitability conditions that are the most favourable to independent producers in the first rounds of auctions: Take or Pay clauses (which do not therefore the single buyer to dispatch them according to variable costs whatever the position of its own equipments in the merit order) and price clauses with a payment structure that contains a significant fixed term.

These clauses “create hostages” -- in the sense of the transaction cost theory(Williamson, 1986) -- and protect investors against any market risk. PPAs structured in this way will then allow the construction of very complex contractual arrangements, which organise financing, purchase and operation of equipment, purchases of fuel, government guarantees through a series of contracts. This is particularly the case with the Build-Own-Operate-Transfer (BOOT, BOO) and Build-Lease-transfer (BLT) arrangements. It must be added that most often, in the institutional and economic environments of the countries in which the Single Buyer model is implemented, the State must guarantee payment for the electricity sold to the single buyer or for guarantees of loans. The advantages and shortcomings of this model must be pointed out in comparison to the public monopoly model and the competition-based reference model.

3.2.1 The advantages and shortcomings of the long-term co-ordination model

Compared to the public monopoly model, troubled by insufficiency of incentive to efficiency and restricted in terms of capacity development by the debt crisis, this model has the advantage of being able to generate chances of raising capital by attracting private operators. But as we will develop, the overcost of the arrangement are very significant in most cases.

Compared to the competition-based model, in which the market signals are supposed to provide the incentive for investment by decentralised and uncoordinated actors, the single buyer model offers a number of advantages.

- It allows planning by the single buyer or by the public authority that oversees the sector. In consequence, it allows avoidance of scarcity situations in which market power could be unduly exercised by the producers.
- It allows a non-volatile and relatively predictable price to be maintained for the wholesale purchasers (distributors, large consumers).
- It offers the guarantees necessary for investors in terms of risk sharing.

The risk sharing clauses in the contracts tend to shift much of the risk onto the single buyer, and therefore onto the public budget of the guaranteeing State and onto consumers for the projects of the first rounds of tendering. Dynamically, however, the relations are progressively more balanced when the institutional environment of the industry is stabilised, that stimulates the confidence of developers and their financiers (Cordukes, 1995; Finon, 1998).

Therefore the limitations of the single buyer model have less to do with its intrinsic faults than with the nature of the institutional and macroeconomic environment in which it is deployed. It assumes that the sector has been partly reformed in order to reach a good level of efficiency; and even when the institutional environment has reached that level, it remains very much exposed to the uncertainties of the macroeconomic environment.

a. The effect of faults in the institutional environment

The single buyer model is sometimes considered to be a way of limiting the political cost of reform by preserving the role of the national electricity company, circumventing partial privatisation to some parts of the industry and avoiding the complex and destabilising introduction of the third party access rule. Because of the stake of payment for the electricity produced by independent producers (IPP), this model is also seen as an incentive to reform the single buyer entity which owns a fleet of generation equipments. It is seen also as an incentive to rationalise the management of distributors originating from institutional separation (reduction of non-payments, non-commercial losses and overemployment), and thus compel the ministerial authority to align the regulated retail tariffs to the costs in order to allow distributors to pay the real costs of wholesale electricity to the Single Buyer.

In fact, it has been observed that this situation has not been achieved in several countries, especially in Southern Asia and in the economies in transition that have adopted it, on two levels (Lovei, 2001). Firstly, the single buyer is often caught in a “squeeze” between high electricity prices under the IPP contracts and the limited income generated by the distributors. Two factors help maintain this squeeze situation: the government authorities’ reluctance to adjust the regulated tariffs, and the lack of incentive for the distributors to reform and improve their performance, especially as they are not in a direct contractual relationship with the IPPs. In order to get round this problem, it is recommended that the distributors contract directly with the entrants in the context of long-term contracts (Lovei, 2001).

Secondly, the programming and contracting function that seems to be one of the qualities of this model can be affected by the deficiencies in the forecasting and programming capacities of the single buyer and the competent ministries, especially as problems of corruption hinder decisions to launch invitations to tender and make selections. This is the case in many countries (Lovei, 2001). As a consequence of this, contracts can be called into question when there is a change of government[15].

b. The additional cost of the Single Buyer model

Even in a credible institutional environment, this type of organisation is not optimal, as it leads to additional costs and risks to the single purchaser and the country's budget, for a number of reasons.

- Firstly, the projects lead to losses in the co-ordination costs with the *Take or Pay* clauses in the contracts; these prevent dispatch of IPPs on the basis of variable costs. In addition, when faced with the erratic macroeconomic growth that leads to periods of overcapacity, the clauses introduce very heavy payment obligations on the Single Buyer during these periods. The model can therefore be criticised for not having mechanisms that reflect the state of tension between supply and demand and for passing the cost of the rigidity of the contractual relationship with the IPP onto the public budget and possibly onto consumers. In comparison, a competition-based model with electricity exchanges will pass the overcapacity situation onto the wholesale prices (Lovei, 2001).
- Secondly, the cost of the contractual arrangements is high or very high for the Single Buyer, compared with its own production costs. The arrangements are contractually very complex and increase the transaction costs in comparison with the projects conducted by the monopoly business. The cost of the independent producers' *project financing* loans (which are therefore not guaranteed on the businesses' general assets) include an increased risk premium, to say nothing of the significant rates of payment on equity capital sought by the IPPs (15-20%). These costs go way beyond what the direct loans from the public company would have cost with the State guarantee on the local or international market, if it had had the opportunity for this; but the lack of possibility to borrow directly is, precisely the problem at the outset[16].
- Thirdly, for the State it does not present any advantages in terms of limitation of public debt, as the loan guarantees are entered into the State's debt undertaking accounts.
- Finally, changes in the macroeconomic environment complicate the fulfilment of independent production contracts and make them much more expensive (Newbery, 2001).The single buyer and the State, which often supplies a guarantee for payment for electricity from the independent producer, are exposed to the very significant currency risk on two levels: the purchase of fuel, the price of which is expressed in dollars even when it is a national fuel, and the repayment of loans. The electricity companies of Asiatic countries have thus been in a critical situation since 1999 in Indonesia, Malaysia and the Philippines following the South-East Asian crisis of 1998[17]. Several projects in the

[15] Lovei points out another fault when he indicates that the incentives attached to the single buyer position lead to the possibility of purchasing electricity from neighbouring countries in the medium term being overlooked.

[16] Incidentally, there are also considerable *ex ante* and *ex post* transaction costs. The BOO and BOOT contractual arrangements must by nature be complex when organising the risk sharing, with multiple contracts quoted between various parties for each of the risks: fuel risk, currency risk, country risk etc. The *ex post* cost of adapting the contracts in the event of a dispute is also very high. The IPP contracts in North countries are simpler because of the much more limited risks and therefore the number of contracts to be defined around a project .

[17] D. Newbery (2001) considers that the fall in the value of South-East Asian currencies caused doubling of the price of PPAs without the companies being able to transfer the costs onto the purchasers. He mentions the example of the Malaysian national company, which suffered the effects of a devaluation of 2.53 to 3.89 MLR/$

process of being realised had to be suddenly stopped following the cessation of payments for their existing equipment.

The contracts concluded in dollars with Take or Pay clauses, which admittedly have a powerful risk limitation function for the independent operators, raise both risk and costs for the buyer and its guarantors. Therefore the Single Buyer model with its long term contracts appeared to be a very sub-optimal solution when several conditions are not fulfilled. It has been seen that difficulties can arise through three main problems: the prevention of risk associated with the Take or Pay clause; the credibility of the single buyer and its mandated resellers -- the distributors -- for raising the income needed to cover the PPA prices, and the currency risk that persists in long-term contracts associated with the purchase of equipment and fuel requiring settlement in currencies.

These difficulties invite to reexamine the alternative of staying with the institutional framework of the reformed public company, which would keep their upstream vertical integration and the monopoly on sales. However, what would be the conditions for restoring their borrowing capacity on the local and international capital market? The minimum prerequisite would be partial control of private businesses over the company which is given the function of Single Buyer and over the distributors, in order to distance the public authorities. A second condition would be the direct contracting of distributors with the independent producers. That is not all there is to it, however.

3.2.2 An hybrid path: a combination of "single broker" and contract market

When the three difficulties can be overcome, how can one resort to the Single Buyer model with some variants? Indeed in some emerging countries, this model may perform firstly because the institutional environment which creates incentive to performance for the distributors assumed to purchase electricity from the single buyer: the distribution is partly privatised and the regulator applies regulation processes that reflect costs (with the exception of social tariffs that have a clearly defined scope). Secondly, the problem of the currency risk is lessened in countries where there is still a significant potential of hydroelectric resources to be developed, that lessens dependency on fuel imports. This may also apply to countries depending on fuel resources not paid for in currency and at opportunity cost, where access to the fuel resources is restricted to national and public energy companies. If the country also has a national electrical equipment industry, the currency risk associated with the independent production contracts could be contained if the local financial market has sufficient room to bear the greater part of the financial needs from electricity investors in national currency. Brazil and to some extent Mexico find themselves in this situation, in which the single buyer model, or a similar model combining a central wholesale buyer and distributors, could work well.

Faced with the third difficulty, that of organising the development of large investments with long lead-times in a context of irregular economic growth, the scheme defined in Brazil in 2003 (PSR, 2003; Medidas Provisoria 144-145, 2003) raised some interesting reflections. It focuses on security of supply in the long term. To do this, the scheme is based on a combination of official mid term (five-year) and long term (ten- and twenty-year) anticipation scenarios which will be sliding scenarios, taking account of equipment realisation periods.

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at the end of 1997 and saw the price of electricity under these IPP purchase contracts rise to US$0.085/kWh while their average sale price remained blocked at US$0.02 in 1998-1999 (World Bank, 1999).

The public authority (with different committees) will be responsible for tracing out three various scenarios for forecasting electricity demand, deciding the capacity amount to auction every five years (with complementary auctions after two years) for the attribution of long term contracts to the concessionary distributors with a very large captive market[18]. A central market operator (the CCEE or Chamber of Commercialisation of Electric Energy) manage the compulsory long-term contract markets and beside it the free contract market.

This scheme limits contractual relations to wholesale exchanges[19]. It will set three main contractual frameworks in motion:

- For each distributor, a basket of shares in long-term contracts (15 years) with all the new and former producers, in order to allow the development of capacities towards the lower official scenario target. Distributors are obliged to buy all their elctricity by the intermediary of the and are not allowed to produce or to self-deal with subsidiary; they could not compete for the supply to eligible consumers outside their respective area. This will necessitate a regular auctioning under the behalf of the public authority and the setting up of a "single broker" who will select the contracts by block of energy for the distributors and define the wholesale price as the average price of the different selected contracts. To avoid the squeeze of the distributors the legal framework guarantee the pass-trough of all the distributor's wholesale purchases on the regulated tariffs.
- Bilateral contracts between investors and very large consumers complemented by vertical integration for very large consumers (but not for distributors), with their own development of capacity and the possibility of onward sale of the surplus on a bilateral basis.
- Transactions on a short term market but only for daily or monthly adjustment for independent producers and buyers (very large consumers), market which will be limited in size by this limited function.

By putting together the three types of arrangement mentioned, this system should guarantee development of capacities in response to demand. If demand grows more quickly than in the reference scenario, the extra demand that the distributors have to face will be satisfied through the contracts selected in complementary auctions in t+2.

The investments organised in this context could be too high in relation to effective demand because the scenario is too optimistic. Individually the forecast by some distributors could be too low, despite the procedure of adjustment of the anticipations. In order to avoid this deficiency in anticipation, the cost of the under-forecasted electricity will be charged to the distributor and not passed through its captive customers beyond a gap of 3%.

This type of system needs to respect two conditions to be stable : that the regional distributors keep a very large captive or stable market, and that they are able to recover any increase in the cost of their supply contracts through the prices. On the first point, the switching of eligible industrial consumers towards direct purchase to a producer will be limited by the level of its power consumption (more than 3MW) and legal restrictions on the notification of switching (minimum of 3 years to switch off and 5 years to switch back). On the second point, despite the announcement of integral cost pass-through on the tariffs, these ones decided on by the

[18] For information, the output demand forecast for the 2012 horizon is between 58,050 and 72,260 MW for a current capacity of 42,500 MW, that is, a need for new capacity of between 9,800 and 18,700 MW, or a simple twofold increase in need (PSR, 2003).

[19] With the exception of a few very large consumers.

Brazilian government which are still quite low for a number of class of consumers do not seem to guarantee recovery of costs *a priori*, which could pose real problems of keeping the system profitable if it is exposed to any opportunism on the part of the public authority.

4. Conclusion

Capacity adequacy seen as a public good and investment incentives have been the major omissions from the electricity industry reforms in both North and South countries. The reason is the optimism on the reformers' part over the capacity of market signals to ensure the development of resources necessary for reliability in the mid- and long-term and to create incentives to invest in base-load and peak equipment.

The solutions designed in **North countries** for facing up to the deficiencies in the market should be understood in relation to the maturity of their electrical systems and their moderate need for new capacities. It has been seen that this problem is being dealt with through the short-term reliability and peak capacity adequacy. However, the Pigouvian and Coasian solutions devised for the peak offers do not appear to be obviously effective, and they are not proved to be a response to the need for base-load equipment in these countries. The overcapacity in most countries' electricity industry has pushed this question back to a later stage. Some countries have put it back indirectly by pursuing other aims, especially incentives to entry through the regulatory authorisation of long-term contracts with higher prices between entrants and distributors with captive markets as in the UK, or the continued vertical integration of production and supply by principal operators, as in Germany, France, Spain and Belgium. These indirect solutions, however, will not indefinitely keep away the need to set up long-term methods of co-ordination, at least for the peak demand, if price crises and shortages keep following each other.

Table 3 : Institutional options for securing generation investments in non-mature electricity industries

	Regulated Verticalized monopoly	**Competitive model**	**Single buyer model**
Structural characters	Vertical et horizontal integration Public regime	De-intégration verticale et horizontale Privatisation	Long term Contract Single buyer Divesture of distribution
Avantage/inconvénient pour l'investisseur et le prêteur	Contrôle des risque-prix et risque- quantité Dependency upon the financing mecanisms - by public budget - and by State borrowing	Credibilization of institutional environment by provision of market rules Difficulty of control of price-risk and quantity risk (answer: search of long term contracts)	Price-risk et quantity-risk
Generic defects	Productive et managerial inefficiency Governmental Instrumentation Absence of private and international financing	Necessity of imperfect competition for attracting investors : -1. Horizontal concentration and wholesale price control -2. Long term Contracts -3. Capture of the regulator	Complexity of project contractual architecture Transaction cost High financial costs in IPPs/BOT projects Risk of squeeze for the single buyer (currency-risk) Imperfect incentives to distributors' solvability

In **developing and emerging countries** facing rapid and irregular growth in their electrical industries, it appears that the sector should be organised principally according to the need to install new capacities in response to the rapid but uncertain increase in demand. In view of the importance of what is at stake, the concepts particular to electricity industry reforms in North countries, which are already imperfect, cannot be transferred without further reflection. If the competition-based, de-integrated model is adopted, it will have to include the competition-based imperfections in order to allow ongoing exercise of market power in order to allow prices to rise above competition prices, or else the model must allow the removal of a significant percentage of transactions outside the scope, most notably through the authorisation of long-term bilateral contracts.

The two main ways identified for getting round the problems of investments are the co-ordination of investment decisions and the limitation of risks for investors through long-term contracts aimed at obtaining the necessary finance. The Single Buyer model could be a good alternative if one wishes to avoid the twists and turns of the competition paradigm, but in order for it to provide an undisputed solution, the institutional environment must be stabilised and the macroeconomic environment predictable, neither of which is the case. The reversal to the public, vertically and horizontally integrated monopoly model as an alternative is not conceivable without major change in incentives for productive and allocative efficiency. There is therefore a need to find hybrid solutions adapted to suit each case but able, in one way or another, to confer the power of co-ordinating investments in production (as in the network) in the ministerial or regulatory authority and to create possibilities for long-term contractual arrangements that allow the outlet and price risks to be limited for investors.

So it is much more logical to design systems that are organised around the need to arrange the investments through the long-term co-ordination and reduction of investment risks. The industrial organisation must be carefully designed, being less concentrated than the old public monopolies and keeping the public authorities at a distance in order to introduce incentives to efficiency. It is likely that in future, there will be a requirement to return to principles similar to that of the Single Buyer model and to give priority to long-term contractual undertakings in developing countries.

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