International Comparisons of Electricity Regulation

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CHAPTER 1

Introduction: International comparisons of electricity regulation

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What is so special about electricity?

As the sun goes down in the evening sky, cities around the world are illuminated in electric light. Photos from satellites orbiting the earth show clearly the outlines of modern society etched against the darkness. We show these pictures on the cover of this book to underline the special role played by electricity in the contemporary world.

Yet, although electricity is a universal feature of modern society, should we expect the firms that produce this universal commodity to be organized along broadly similar lines internationally? There are prima facie arguments on both sides. On the one hand, common factors of production and technological history suggest broad institutional similarities. On the other hand, the influence of particular national traditions, political culture, and experience argue for differences. There is no definitive answer to this question, but it is becoming more and more interesting for those who follow institutional developments in the industry and those who seek to improve economic efficiency in the electricity sector.

The electricity industry in many countries is experiencing a wave of structural change. Much of this we document here. It is not immediately clear, however, why reorganization of this industry is occurring now, what is the driving force, and whether there will be an international convergence in its structure. Our inquiry will help to address these large and somewhat mysterious questions.

The research represented by this volume is a collaborative effort of academic investigators from around the world. Each chapter describes the electricity industry and its regulation in one country (or several geographically proximate countries). By its very nature electrification draws in government involvement. Public land must be used for establishing distribution networks. National resources, river basins, and subsurface minerals are frequently exploited as inputs to electric power production. There are natural monopoly features to the electricity industry in every country. Moreover, government is involved at every point in the determination of the framework in which these resources and opportunities will be employed. The interactions between government and the electricity industry vary widely from country to country. We will refer to these relations broadly as the regulatory structure of a particular country.

The regulation problem[1]

Natural monopoly and competitive elements

When a single firm can provide a range of specific goods or services at lower total cost than a set of firms can, we say that a natural monopoly condition exists. This cost condition is not itself sufficient to justify a monopoly structure. The cost advantage would need to be sufficient to offset the additional costs of regulating the resulting monopoly. More competitive structures may raise production costs but reduce regulatory costs or allocative inefficiencies sufficiently to provide the service at lower total social cost. Several countries are actively encouraging duplication of telephone lines to customers in the hope that the resulting competition will reduce the overall costs of service. There are even cases where this occurs in electricity.

Berg and Tschirhart (1988) cite Farrer's (1902) catalogue of typical characteristics of natural monopolies:

1. Capital-intensity and minimum economic scale.
2. Nonstorability with fluctuating demand.
3. Locational specificity generating location rents.
4. Necessities, or essential for the community.
5. Involving direct connections to customers.

Some of these attributes contribute directly to the likelihood that a single firm will have lower supply costs within a well-defined area. If the output can be stored or readily shipped to dispersed customers, then the size of the market in which firms may compete increases, and the larger market may be able to sustain more than one firm at minimum economic scale. The combination of necessity (i.e., low demand elasticity) and direct connection (i.e., specific investment) implies large potential exploitative power by the producer, ensuring that regulation or public ownership will be politically inevitable.

It is clear that electricity fulfills these conditions closely. Because electricity cannot be readily stored, supply must be continuously adjusted to varying demand. At one extreme, each customer could have a generator, but the spare capacity required to meet peak demands would be excessively costly, as would having inefficiently small plant. As a result, numerous consumers are supplied

[1] This discussion follows Newbery (1994).

by each utility through a distribution system. Up to some limit, the larger the number of consumers served, the lower the average operating and capital costs, for smaller proportionate reserve margins are required, whereas larger generating stations with lower running costs can be built and the benefits of scheduling stations of differing variable costs in a merit order can be realized. These scheduling advantages require central dispatch, and the full advantages of an integrated network system require coordination between investment in generation and transmission. The cost economies typically offset the cost of the network infrastructure. These facts were generally recognized at the level of municipal distribution by the last decade of the nineteenth century. By the second decade of the twentieth century, they were also apparent with respect to high-voltage transmission.

The demand for regulation

Network natural monopoly industries like electricity must inevitably be subject to social control. Scale economies and specific assets (those with high costs for consumers to switch suppliers), particularly in distribution, provide the network owner with considerable market power. The political and social demand for control of this market power arises from (1) the nonstorability of supply, (2) the dependence of the consumer upon the supplier, and (3) the essential nature of the service. Local or central governments have therefore always stood ready to require suppliers to guarantee access on fair terms. Because suppliers need rights of way, governments have the leverage to impose an obligation on supply.

There is a counterpart to this demand for regulation, for the electricity industry is capital-intensive, and its assets are durable, long-lived, and immovable. The political demands for access and "fair" or nonexploitative prices mean that investors must expect that after they have sunk their capital they will be limited in the prices they can charge, and subject to possibly onerous obligations to supply, to guarantee security, stability, and safety. Therefore the incentive to invest depends critically on expectations of the future pricing policy. Will it be set at a sufficiently remunerative level to justify the investment? There are reasons for doubt. Once the capital has been sunk, the bargaining advantage shifts toward those arguing for lower and possibly unremunerative prices. This is not baseless fear. There are numerous examples of countries failing to adequately index the prices of public utilities in periods of inflation (see the discussion in the section titled "Measures of performance").

In its extreme form, one might ask why should anyone sink money into an asset that cannot be moved and that would not pay for itself for many years? A confident investor would have to believe that the asset would not be expropriated, either explicitly, or implicitly through a stream of returns that would not be sufficiently remunerative. Durable investments thus require the rule of law, and specifically the law of property, which is a public good provided by the state. If the state exists primarily to enforce the rights of property owners, then there is no problem since the state just protects owners. But by the time electricity became important, the state also represented workers, voters, and consumers. The resulting conflicts of interest weakened property rights as the coercive power of the state could be used not only to enforce laws, but also to regulate economic activity, impose taxes, and even to expropriate property.

If the industry is to be successfully privately financed, then regulation must credibly satisfy the demands of both consumers and investors. Some countries, notably Germany, Japan, and the United States, have managed more or less to solve this problem by using different strategies (see the section titled "The organization of this book"), but many have failed. If it is not possible to create an efficient and credible system of regulation, then public ownership will be the only alternative. Indeed, the simplest explanation for Short's (1984) observation that throughout the world most network utilities exhibiting natural monopoly with significant specific assets are in the public sector is that it was not possible in the private sector to devise a satisfactory and credible system of regulation that would both attract finance and deliver the service at lower cost.

Each jurisdiction must therefore find a solution to the basic problems of reassuring consumers and investors (who may be the taxpayers), though not all solutions will be equally satisfactory. A good system of regulation will command the support of consumers, will provide sufficiently remunerative prices to enable investment to be financed, and will do so at low cost, which in turn means that investors have confidence that their investment will be able to cover its financial costs. In turn, investors will coordinate investment in transmission and generation to secure the least-cost expansion of the system consistent with adequate security against system failures, fuel shortages, and price shocks. Because electricity is vital to production, governments must also be convinced that its supply will be under adequate domestic control in times of international tension or conflict.

How can the regulatory system be designed to reassure private investors? The experiences documented in these chapters illustrate various solutions. One approach is to provide constitutional guarantees to a fair rate of return, as in the United States, upheld by an independent legal system that protects property rights, or by creating sufficiently independent regulatory agencies supported by appeal procedures to guard against expropriatory behavior. Another solution is a regulatory compact in which the costs to the government of intervening to impose tighter regulation outweigh the benefits in terms of lower prices and short-run voter support. Many countries in continental Europe have evolved systems of essentially self-regulation in which prices are kept remunerative but not exploitive and supply and quality are satisfactory, so that the government has little obvious reason to intervene. The self-regulation system is feasible under public ownership or under a system of mixed public and private ownership. What is critical is that there be some protection against political intervention. In the public ownership case particularly, such protection may be facilitated by the division of responsibility between the various tiers of government (central and local, or state and federal). The other principal protective mechanism under government ownership is the reliance upon political consensus (as in a coalition). The political equilibrium would be disturbed by intervention, or because the consequences of intervention would be self-evidently damaging.

Different regulatory solutions

The history of the electricity industry in various countries illustrates the variety of solutions that have been found to the problem of balancing the interests of consumers and governments while still enabling efficient investment. The solutions available to any jurisdiction are constrained by politics, history, endowments, technology, and the state of the economy. The solutions, formulated in terms of ownership structures, fall into three main types. The electricity industry may be entirely publicly owned and hence directly subject to political control and access to funds, or it may be entirely private but regulated either explicitly or implicitly, or it may be a mixed system in which the private sector is implicitly controlled by the potential of the remaining publicly owned system to take over its function. In addition, the type of regulatory system may be local, regional, or national.

Local (or municipal) regulation could function in principle so long as generating stations were small compared to local demand, but it became clear very early that there were substantial economies in building larger units and serving larger market areas by using higher-tension transmission systems. The main problem to solve was how to transfer responsibility for electricity supply from the local level to an authority covering a sufficiently large number of consumers. This transfer of authority was necessary to reap economies of scale while preserving satisfactory representation of local interests, without encouraging free-riding or appropriation of investment by other interests. Achieving scale economies requires solving the problem of coordinating investment in generation and transmission to secure least-cost delivery of electricity. The key to this was the creation of an integrated transmission system within some area, which in turn had responsibility for dispatching power stations in merit order, thus securing the least-cost generation of electricity.

The details of regulatory structure in various countries often stem from the different solutions found to the problem of breaking out of the constraints of the local municipal-based undertakings. The chapters themselves describe the historical and institutional factors that have influenced the present regulatory structure of each country. The British story, told in Chapter 2, is perhaps the most dramatic in the variety of structural reforms that have characterized its evolution. Other countries have typically adopted a more evolutionary approach to regulation, though several have found nationalization necessary to achieve the required structure to support subsequent coordination in investment and operation.

The monopoly regulation literature

Monopoly regulation has attracted the close attention of economists for decades, and there is an extensive theoretical and empirical literature that predates the more recent framework of economics of regulation. The chapter authors have written their contributions in the light of these precursors, which are briefly surveyed here.

Theory

The longest line of economic theory on regulation has emphasized normative aspects of natural monopoly pricing. In the 1970s a large amount of research was devoted to refining precise definitions of the natural monopoly concept (Baumol, Panzar, and Willig, 1982). The optimal pricing literature for natural monopolies emphasizes the efficiency benefits of pricing at marginal costs. This general notion was adapted to regulated industries characterized by the common capacity problem (i.e., where fixed facilities produce the same physical good at different times of the day or seasons of the year). Numerous authors developed the implications of this technological situation under the general framework of "peak-load pricing" (Boiteux, 1960). Where firms use marginal-cost pricing without government support for fixed-cost recovery, various nonlinear tariff schemes have been discussed to cover the potential revenue deficits (Brown and Sibley, 1986). Laffont discusses the application of these ideas to tariff design at Electricité de France in Chapter 10.

The older normative pricing literature presumes an exogenous cost function with managers and employees minimizing costs given the level of output. The first questions about managerial incentives were raised in the context of input choices by Averch and Johnson (1962). In their model, the regulator enforces a constraint on the rate of return the utility is allowed to earn. This constraint is set at a level above the cost of capital and creates an incentive for the firm to accumulate an excessive amount of capital relative to the cost-minimizing level. The Averch–Johnson paper stimulated a large literature drawing out the implications of the model for firm behavior and eliciting numerous efforts to provide empirical verification (for example, Courville, 1974).

One of the most prominent themes of the more recent literature on regulation is the application of the principal–agent framework to the relationship between the regulatory authorities and the utility (Laffont and Tirole, 1993). The basic insight on which this research program is built is the profound gap between the firm's knowledge of its costs and capabilities and the information available to the regulator. The regulatory problem is then defined as a trade-off between rent extraction and incentives. Regulators give the firms incentives to fulfill the social objective, and the price of this compliance is a rent allocated to the firm. We will find many aspects of these ideas reflected in the country studies.

Empirical studies

A substantial empirical literature comparing the performance of investor-owned electric utilities (i.e., privately owned) with publicly owned utilities (state or municipally owned) was surveyed in Vickers and Yarrow (1988, pp. 40–3). They conclude that there is little to choose between public and private ownership in terms of technical or cost efficiency, and caution against supposing that public ownership leads to greater allocative efficiency, which they argue is more dependent on the form of regulation. The majority of the studies focus on the United States, and any expected consensus about the superior performance of privately owned firms fails to materialize. Many of the early studies, such as Peltzman (1971), focus on prices as the main data from which efficiency is estimated. With increasingly sophisticated statistical techniques available, later authors began to examine reported costs. Representative studies include Pescatrice and Trapani (1980), who find greater cost-efficiency in the publicly owned sector of the U.S. electricity industry than in the privately owned sector. The opposite conclusion is found by Hollas and Stansell (1988), but their result is only short-run in nature – that is, they treat capital as a fixed input. This assumption ignores the whole set of issues raised by the Averch–Johnson paper.

These results are questioned by the findings of Atkinson and Halvorsen (1986), perhaps the most careful of the recent studies on U.S. data. The Atkinson and Halvorsen study eliminates biases in the specification of the cost model. Their result is that no efficiency difference can be detected between the privately owned and the publicly owned firms. The same conclusion is found by Hjalmarsson and Viederpass (1992) for their more limited study of electricity distribution in Sweden.

The most recent and thorough empirical investigation of electric utilities is provided by Pollitt (1993, 1994). He subjects two recent datasets to exhaustive comparisons of efficiency. Following Farrell (1957), technical efficiency is measured as the extent to which the utility reaches the technical production frontier, variously estimated, whereas cost efficiency is the extent to which the utility minimizes cost at prevailing input prices. A utility can be technically efficient but not minimize its costs. The first dataset is an international sample of 95 utilities operating in nine countries in 1986, and thus it is considerably more recent and comprehensive than the earlier studies, largely done on 1970s data and in the United States. Depending on the approach used, Pollitt finds evidence for no significant difference in technical efficiency between the two ownership types but some evidence for the superior cost-efficiency of private utilities. The second dataset is an international sample of 768 power plants in 14 countries in 1989, which together produced about 40% of world thermal electricity. This plant-level analysis, using four different methodologies for measuring technical efficiency, finds that private firms are statistically significantly more technically efficient than are public firms, once the efficiency scores are pooled (Pollitt, 1994). The failure to find significant differences in technical efficiency in the first (and other, earlier) studies reflects the inadequacy of their sample size for detecting rather small differences in measured technical efficiency, reducing cost by between 1 and 3%.

To measure cost efficiency, Pollitt then takes the 164 of the 213 base-load plants in the dataset for which input price data could be found. He rejects the hypothesis that public utilities are as efficient as private, finding private utilities to be more efficient both in minimizing costs and overall, though the difference is quantitatively small – perhaps 5% higher efficiency (the difference varies with the methodology employed). Well-run public utilities can certainly equal the performance of average private utilities.

The evidence from Britain is that privatizing the generators and forcing them to compete in the bulk electricity market resulted in dramatic improvements in labor productivity by halving the workforce within three years, and in much closer control over investment costs. It is noteworthy that the publicly owned company Nuclear Electric also improved its productivity quite dramatically, as did the publicly owned British Coal, both forced to sell into markets facing competition from private firms or imports. In Argentina, generation availability dramatically improved within a short period after the reforms, with Central Costanera improving availability from 20 to 50% with a doubling of output (Perez-Arriaga, 1994). Norway introduced competition into the bulk electricity market and created Statnett Marked (as a subsidiary of the state-owned owner of the transmission system Statnett) to operate the power pool in 1993 without altering the ownership structure of the industry. The effect has been to induce substantial trade across former franchise boundaries with a decrease in the dispersion of prices (Moen, 1994). In a hydro system like that in Norway, changes in patterns of supply will have negligible effects on short-run costs, and it is too soon to tell whether creating an integrated and competitive market will eliminate inefficient local investment in generation and induce moves toward more efficient-sized distribution companies, which was a large part of the goal of the reforms. In time, the Norwegian example should provide an important test of the relative importance of creating contestable power markets by restructuring the industry, compared to privatization. Note, however, that the Norwegian system allows private generation to compete with state- and municipally owned systems.

The English regional electricity companies (RECs, or distribution companies) remain natural monopolies, and their performance does not appear to have changed markedly since privatization, though neither has it deteriorated. The same seems to be true in Argentina and Chile judging from the case study of Enersis reported by Galal (1994). Because they do not have large investment requirements in Britain, their considerable ability to earn profits in a protected market has not been required to finance investment (as it has been for the privatized water companies with their large backlog of replacement and upgrading investment). The evidence from elsewhere is that the main requirement of the ownership structure of distribution companies is that they should be large enough to reap economies of scale, and they should ideally be subject to an element of benchmark regulation. Their role and ownership may also be influenced by the way in which transmission is organized and the form of the obligation to supply, which, in a de-integrated system, will need to be devolved to the distribution companies.

The Pollitt study, along with the preceding anecdotal evidence, is consistent with the view that the more important determinant of efficiency is the degree of competitive pressure put on the utility, which in turn depends on the extent to which a utility has to compete for its market, and on the quality of regulation, though private ownership appears to provide some additional improvement. Private owners typically perform better in competitive markets, particularly where innovation is important or least-cost solutions require careful and informed choices, and where costs need to be closely monitored. Generation is therefore a natural choice for private ownership, particularly if it is associated with open access to transmission. This combination would allow private enterprises that self-generate to sell surplus power and improve the competitiveness of the bulk electricity market.

A whole range of other empirical studies has been surveyed by Joskow and Rose (1989) in the context of regulated industries as a whole. Topics important in the case of electricity include the effect of regulation on input choices (i.e., biases regarding choice of capital, fuel, and labor) and the distributional impacts of regulation.

Comparative institutional approach

This book belongs to a genre that is intermediate between the standard theoretical and empirical approaches. We emphasize comparative institutional performance, giving due consideration to historical and political conditions.

There are costs and benefits to this approach. The authors make use of the insights provided by theory, but they frequently find that the stylized textbook models omit important features of reality. Similarly, although the empirical studies are also useful, most do not cover a range of different regulatory regimes, or transitions between different regimes, and frequently fail to find important effects. The advantage of the comparative approach adopted here is that the reader should be able to gain a sense of perspective of the major determinants of industry performance, and both the potential for and constraints on regulatory reform. Such reforms are increasing, and although the present form of some regulatory systems described here may well have changed by the time this book reaches the reader, the lessons from experience should endure.

The comparisons across countries suggest that economic institutions have an inertia and robustness that survive the inevitable twists and turns of debate on public policy. There is a danger in focusing on the immediate policy issues that the larger and longer-acting forces shaping the industry will be overlooked. It is our hope that this study of the institutional structure of the electricity industry will reveal something of these forces and thereby inform future theoretical enquiries into regulation and the more immediate policy debate.

Measures of performance: Excess capacity, relative prices, and long-term productivity

There is no consistent international database that would allow sophisticated statistical comparison of economic performance in electricity. As a substitute, however, we collected a small amount of data for the countries studied here to develop at least a simple picture of common trends and variations. Tables 1-1, 1-2, and 1-3 summarize our results for three performance measures: reserve margins, relative prices within a country, and long-term productivity. Each table tells a reasonably coherent story. Together they provide a global view of the investment process in electricity in the past three decades and some insight into its financing.

Reserve margins

Reserve margins in electric generating capacity are necessary to maintain reliability of service in face of the random breakdown of operating equipment. The high costs of storage make redundant capacity the only practical method for achieving reliability. The economic problem is to optimize reserves at a reasonable level. This optimization must account for both the electricity supply system characteristics and the cost of outages to consumers. Engineering

Table 1-1. *Reserve margins*

	Reserve Margin (Capacity) (Capacity – Peak) / Peak		
Country	1970	1980	1990
Chile	139.4%	90.4%	94.1%
Uruguay	25.9%	27.7%	67.6%
Canada	19.0%	28.0%	20.0%
France	Not Avail.	24.3%	27.1%
Germany	20.4%	39.2%	42.8%
Japan	3.4%	24.9%	4.0%
New Zealand	33.6%	52.3%	37.9%
Sweden	43.0%	58.0%	45.0%
United Kingdom	27.6%	33.1%	20.2%
United States	19.3%	30.4%	22.7%
Yugoslavia	41.0%	53.0%	80.0%

methods to characterize the probability of outages as a function of supply system parameters have been developed over decades (Billinton and Allen, 1984). The valuation of electricity outages, on the other hand, has been undertaken only more recently and requires expensive surveys and sophisticated analytical technique (see, for example, Woo and Train, 1988). Studies of the trade-off between outage costs and reserve capacity tend to result in optimal reserve margins in the 15 to 20% range for predominantly thermal power systems (Southern Company Services, 1991). For hydroelectric systems, these measures are less meaningful, since rainfall variation, not equipment breakdown, is the primary reliability problem.

Table 1-1 shows the data on aggregate reserve margins (i.e., capacity minus peak demand divided by peak demand) for each country where data were available for 1970, 1980, and 1990. These data show an underlying tendency toward apparent excess capacity (i.e., reserves above the 15 to 20% level). In some countries this tendency is minimal; in others it is more extreme. Of the industrialized countries, only Japan exhibits anything resembling potential shortages, presumably because of very rapid economic growth. The long lead time on power plant construction, particularly compared to turns in the cycle of economic activity, can result in mismatches between capacity additions and demand. The tendency toward excess capacity appears to result from an asymmetry between the social penalties of a shortfall (very severe) and those from excess capacity (only moderate). It is not an accident that firms would choose to err on the side of excess capacity.

Table 1-2. *Relative prices*

	Industry/Residential			Commercial/Residential		
Country	1970	1980	1990	1970	1980	1990
Argentina	0.54	0.45	0.93	1.29	1.18	1.93
Brazil	0.38	0.44	0.65	1.00	0.80	1.35
Chile	0.37	0.57	0.59	1.29	1.44	0.93
Uruguay	0.75	0.71	0.80	1.90	1.43	1.11
Canada	0.44	0.61	0.69	0.78	0.90	0.99
France	0.42	0.62	0.35	0.42	0.66	0.58
Germany	0.56	0.63	0.63		Not Available	
Japan	0.41	0.71	0.68		Not Available	
New Zealand	1.38	1.36	1.17	1.92	1.70	1.44
Sweden	0.48	0.45	0.43	0.70	0.75	0.63
United Kingdom	0.76	0.70	0.59	1.13	0.92	0.83
United States	0.79	0.88	0.86	0.96	1.02	0.93
Yugoslavia	0.35	0.74	0.70		Not Available	

The economic optimization framework from which one would derive an estimate of efficient reserve levels still has many conceptual problems. The surveys used to estimate outage costs may be unreliable, in particular because they fail to deal with adjustments consumers might make in anticipation of outages. Indeed, many very sensitive consumers already make such adjustments. Another conceptual problem is the valuation of social costs from widespread interruptions in electricity service. The disruption due to riots and looting during power outages is a real factor motivating government attitudes toward reliability, but this is never an explicit factor in the cost-benefit analysis of reserve margins. The aversion of governments to power outages is an intuitively meaningful factor in the behavior of firms; making it a coherent part of the assessment of excess capacity has not yet been done.

In Chapter 2, Newbery and Green offer an interesting account of the motivation for excess capacity in the United Kingdom. They attribute part of the responsibility for excess capacity to marginal-cost pricing. By pricing low in the face of excess capacity, the demand for electricity is stimulated, thereby justifying future capacity additions. This mechanism is really produced by a configuration in which managers want to oversee a large construction program of new capacity and in which no single regulatory authority is paying sufficient attention to prevent mispricing and excess investment. Waverman and Yatchew in Chapter 8 make similar observations about Canada. This measure of investment performance confirms the ability of all the regulatory systems

Table 1-3. *Historical trend in real prices*

	Historical Trend in Real Prices Continuous Growth Rate	
Country	1950–74	1974–90
Canada	–0.74%	2.09%
France	3.23%	–0.04%
Germany	–2.06%	0.27%
Japan	–1.75%	0.16%
New Zealand	–1.95%	1.11%
Sweden	–2.60%	–1.50%
United Kingdom	–2.99%	0.64%
United States	–2.55%	1.68%
Yugoslavia	Not Available	3.40%

examined to facilitate investment. How it is financed and whether it is efficient remain to be seen.

These data suggest no clear conclusion about such propositions as the claim that rate-of-return regulation, for example, induces excess capacity, which in some cases may appear to be higher reserve margins. Moreover, the various technology mixes across countries make even this observation imprecise.

Relative prices

A direct comparison of electricity prices in different countries would be a desirable way to compare performance, but there are conceptual and empirical problems associated with such exercises. Henney (1992), for example, compares prices for various kinds of electricity consumers in Western Europe using European Currency Units (ECUs) but removing the effect of taxes. Using currency exchange rates for broad international comparisons across widely differing economies is generally inferior to purchasing power parity (PPP) when nontradable goods are involved (Kravis, Heston, and Summers, 1978). Although PPP is an improvement over exchange rates, it is not a universal key to all interesting questions involving international comparisons (Sen, 1979). At the heart of PPP methods lie a number of index number issues that are difficult to resolve (Kravis, 1984). Rather than immerse ourselves in these, we adopt a simpler and somewhat less ambitious approach.

We address price performance in two different ways. First we look at potential cross-subsidization by examining relative prices. For each country we