Vertical Restructuring of the Infrastructure Sectors of Transition Economies

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Abstract

One important determinant of the speed and success of transition will be the efficiency of transformation and development of the infrastructure sectors. A great deal of attention has been paid to issues such as privatisation, restructuring, user prices, and terms of access in these sectors, regarding both developed and developing countries. Some issues regarding vertical restructuring are notable in the degree to which in different sectors and in different locations they raise similar questions that may have very different answers. This paper suggests a framework for answering such questions and seeks to apply it to the railroad, electricity, and telecommunications sectors in Russia, Lithuania, Romania, and Poland.

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"There you have it -- reforms on unprepared ground,
and copied from foreign institutions as well --
nothing but harm!"
The Devil, in Fyodor Dostoevsky, *The Brothers Karamazov*, Book 11, Chapter 9, "The Devil. Ivan Fyodorovich's Nightmare"

In economies around the world, the infrastructure sectors are in a state of flux. The traditional model of state ownership and operation has yielded much ground to privatization and long-term concessions. The traditional model of monopoly service provision has similarly yielded ground to competitive restructuring in some markets. And the traditional model of vertical integration that accompanied state ownership and monopoly provision has sometimes yielded to vertical "unbundling", to accounting or functional separation, or even to full vertical separation of ownership.

Yet the process of change is far from complete. Although there have been many models presented that suggest how an infrastructure sector might be best restructured and operated, there is no consensus that a single model is best. Advocates of various forms of vertical separation cite the benefits of competition and deregulation and the dangers of discrimination and favoritism; defenders of vertical integration point to economies of scope. Most advocates of one model or another would probably admit at least that their arguments are stronger regarding some infrastructure sectors than others: what works for telecommunications may not work as well for railroads. Similarly, most advocates of one model or another would probably admit at least that their arguments are stronger in some settings than others: what works for

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the UK may not work as well for Chad. Indeed the criteria for which model works "best" are different in different situations: developed countries tend to be seeking increased efficiency, while developing countries may be more concerned with network reach and expanded access and usage.[2]

However, while there has been a great deal of valuable work examining both the broad issues involved and their application in particular circumstances, I know of no systematic study that examines the applicability of different models to different sectors in different settings. It is the purpose of this paper to suggest a framework for just such an examination. After setting out what I consider to be the most important questions to be answered in a particular application, I will suggest preliminary, comparative solutions for three important infrastructure sectors -- electricity, telecommunications, and freight railroads -- in four diverse transition countries -- Lithuania, Poland, Romania, and Russia.

1. The Issues

Consider an infrastructure sector with two vertically related stages of production, the product stage (P) and the network stage (N). Traditionally both the P and the N stage were considered to exhibit "natural monopoly" characteristics: the cost functions were such that, at relevant levels of demand, it was cheaper for one enterprise to produce all of P (N) than for multiple enterprises to compete to sell units of P (N) to the same customers. The joint production by a single enterprise of both P and N was considered to exhibit natural monopoly characteristics as well: the joint cost function was such that, at relevant levels of demand, it was cheaper for one enterprise to produce both all of P and all of N than for one natural monopoly enterprise to produce all of P and another to produce all of N. The vertically integrated natural monopoly enterprises that either came into being via the market or were purposefully created by policymakers were to be prevented from exercising monopoly power over their customers by either government regulation, the solution first widely applied in the US, or government ownership and operation, traditionally the preferred solution in most of the rest of the world.

[2] Armstrong and Vickers (1996).

In the past few decades, a combination of technological advances and improvements in economic understanding has called into question some of the fundamental assumptions upon which the structure just described was based. In particular, in virtually every infrastructure sector, there is now some P stage where the validity of the assumption of natural monopoly is somewhere in the range from doubtful to clearly wrong. A natural result has been widespread sentiment for some kind of restructuring to allow the forces of competition to work in these stages. The portrait painted of many independent enterprises in a competitive P stage supplying customers through a natural monopoly N stage is in many ways a compelling one.[3]

The problem, however, is the conjunction of this model with the model of vertical integration. It is generally *not* believed that the demise of natural monopoly conditions in the P stage has removed the vertical economies of scope between the P and N stages. But if N continues to be provided by a regulated monopoly enterprise, should that N-providing enterprise operate as one of several competitors in the P sector? The presumed persistence of scope economies would suggest a positive response, but there is a serious argument on the other side as well: the N monopolist will in many circumstances be able to increase its profits at the expense of society by favoring its own integrated P supplier over competing P suppliers. If regulators of the N stage are unable to detect and/or prevent such discriminatory treatment, many of the benefits of competition in the P stage may be lost, casting doubt on the benefits of the overall liberalization project.

This discussion suggests a number of questions to be answered concerning a particular infrastructure sector in a particular country at a particular time before one can reach an informed and convincing judgment as to the best form of restructuring (if any). The most important would seem to be the following:

[3] Clearly if the N stage begins to lose its natural monopoly characteristics as well, a separate set of questions arises. Spiller and Cardilli (1997) and Noll (1999) argue that this is becoming the case regarding local telecommunications services. I will discuss this further below. Ordover, Pittman, and Clyde (1994) suggest conditions under which electricity and railway (and other infrastructure) service providers may lack monopoly power.

- How extensive, in fact, are the scope economies between the production of P and the production of N? Would these scope economies be markedly reduced by the opening up of the P stage to competition? In addition, it is important not to focus simply on issues of static efficiency. One of the most important issues raised by vertical separation is the degree to which the owner/controller of the N stage will receive the correct incentives for investments and improvements if it does not operate in the P stage.[4]

- How extensive are the likely benefits from competition if the P stage is opened up to entry? Have economies of scale in P really been reduced sufficiently relative to likely demand levels that a "workably" competitive P stage is a likely outcome?[5] Are entrants likely to be important agents of technological innovation in this sector?

- How difficult is it for regulators to detect and prevent favoritism on the part of the N enterprise towards its related P supplier? This may be the question where the qualification of "in this sector in this country at this time" is most important, as regulatory capabilities will vary a good deal across different situations. In particular, transition and developing economies often lack both a political tradition of independent regulators and a judiciary of sufficient strength, independence, and competence to enforce regulatory orders.[6]

- If regulators cannot detect and prevent favoritism, how much harm does favoritism do to competition and welfare?

The answers to these questions will in turn point to one of several structural policy options. I will consider three polar cases, though there are clearly various intermediate choices that may be available in practice:

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[4] An additional issue related to economies of scope is the supply of relevant human capital. Is there likely to be a severely constrained supply of the human capital qualified to operate enterprises in the overall sector, making vertical separation a ruinously expensive strategy?

[5] This is a point emphasized by Shepherd (1997). "Deregulation is often plagued by a mistaken belief that getting a little competition is as good as achieving fully effective competition."

[6] World Bank (2001).

- *A vertically integrated monopolist.* This is the traditional model described at the beginning of this section of the paper: a single, fully integrated enterprise operates as a monopoly producer at both the P and N stages of the sector. The actual market power of such a "monopolist" may be sometimes be tempered by intermodal competition or by competition from adjacently located integrated monopolists, as when two railroads or two long-distance electricity transmission lines serve the same city from different directions.

- *Vertical separation.* A single enterprise operates as a monopoly producer of N. There is competition in the production of P, but the N enterprise is not permitted to enter that market.

- *Vertical integration with competition.* A single enterprise operates as a monopoly producer of N and as one of several competitors in the production of P. This option will often include some kind of "functional unbundling" as an attempt to prevent discrimination, such as the keeping of separate accounts by the N and P suppliers within the integrated enterprise and the regulation of the internal prices charged by the integrated enterprise to itself for use of the N-stage network.

Of course, I am abstracting from a good deal of interesting detail here.[7] For example, the question of how, exactly, to make "functional unbundling" work is one that has attracted a great deal of thoughtful examination, including a burgeoning and highly sophisticated literature on the terms of access to the network by unintegrated producers of P. I will hope to make up for the missing detail with insight into some of these broader questions.

2. The Sectors

Freight railroads, electricity, and telecommunications are three of the most important sectors for the success of an economy in transition. All three have been the subject of extensive discussion in developed, transition, and developing economies concerning the possible benefits of liberalization and restructuring. The discussion raises similar questions in the three sectors, but the sectors are sufficiently varied that the answers may be very different. Let us consider the three in broad outline before examining the situation in particular countries.

2.1. Railroads

[7] A recent paper by Buchler (2001) examines these same three structural options from the standpoint of a price theoretic welfare analysis, while holding constant some of the regulatory issues discussed here.

The earliest railroads in both England and the United States were built on the "turnpike" or "canal" model, with the provision, sometimes stated specifically in authorizing legislation, that the way would be open to any user who paid a toll and abided by the rules of the line.[8] This "vertical integration with competition" model seems to have operated successfully so long as the freight was hauled by horses. However, with the introduction of locomotives, it proved inefficient and unwieldy for horse-drawn and locomotive-powered vehicles to share the same way. As the owners of the track were typically the only owners of locomotives, the turnpike model was fairly quickly abandoned, and a "railroad" came to mean an integrated monopoly enterprise owning the track and way and operating the trains.[9]

This model persisted with little controversy until the 1980s, when Sweden restructured its national railroad into separate train operating and track owning enterprises and Margaret Thatcher's Conservative government in the UK began taking steps both to privatize British Rail and to open up the track to competing train operators. The Swedes hoped to create "competition on the rails" through their restructuring, but their primary rationale was to make more transparent the financial accounts and operations of the track infrastructure stage, and thus to make better informed policy decisions concerning relative government support to road and rail. Similarly, while reformers in the UK hoped to create a more competitive railroad sector, it is fair to say that their primary focus was on the privatization process itself, and the transfer of one more economic sector from government to private control.[10]

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[8] Sherrington (1928, at 226) notes that "the first Act of the [UK] legislature which may be said to affect rail transport added the words 'tram-ways' and 'rail-ways' to the provisions already applying to turnpike roads and canals."

[9] See Lardner (1850), at 107-8 and 421-2; Lewin (1925), at 39; Stover (1961), at 21; Walras (1980), at 88; Overby (1982), at 11-12; Kirby (1993), at 15, 37, 60, 90-1, and 95; and Simmons and Biddle (1997), at 328-29. I am grateful to Gordon Biddle for his generous and helpful suggestions and explanations on this point.

[10] For Sweden, see Hansson and Nilsson (1991) and Tysklind (2000); for the UK see Welsby and Nichols (1999).

As the Swedish and UK reforms were in progress, the Council of the European Union enacted Directive 91/440/EEC, requiring member countries to begin a) taking steps to separate the accounts of track and train operations and b) making provisions for international trains from other member countries to operate over the tracks of each country.[11] This regulation, like EU competition legislation, seems to have been enacted as much for the purpose of furthering integration of the Union as for the creation of competitive conditions on the rails. Nevertheless this scenario of competing trains operating on a monopoly track has gained many adherents worldwide, and many railroad privatization plans include some provisions for vertical separation and/or competition among train owners.[12]

The principal alternative restructuring model has been that chosen by Mexico, Argentina, and Brazil: a system of vertically integrated monopolists each of which serves its own territory but each of which serves competing shippers at at least one point of intersection, in a phenomenon called "geographic" or "source" competition. The Mexican system is the oldest and best realized of the three (though both the US and Canada are increasingly relying on the source competition model as well). In Mexico, the railroads were restructured so that three vertically integrated companies all serve Mexico City (on jointly controlled tracks) but from there go in different directions: one northeast to Laredo and Gulf ports, one east to Veracruz, and one northwest to other US border crossings and Pacific ports. A small number of points other than Mexico City are jointly served by two railroads, and there are provisions (not yet implemented) for limited track access to provide alternatives to captive shippers, but in the main the reliance is on source (and intermodal) competition to protect shippers while enjoying the benefits of liberalization.[13]

How does the railroad sector stack up as a candidate for restructuring?[14]

1. Economies of Scope. Although a great deal of useful work has been done estimating railroad cost functions, this work has tended to focus on the measurement of economies of scale and density rather

[11] See, e.g., Holder (1999).

[12] See Ordover and Pittman (1994); ECMT (1998).

[13] For Mexico, see Garcia de Alba (2000). For Brazil, see Estache, Goldstein, and Pittman (2001). For Argentina, see Kopicki and Thompson (1995).

[14] See also Massa (2000) for a discussion of some of these points.

than economies of scope between track ownership and train operation, and thus will be discussed presently. The econometric study that seems most relevant to this latter issue, that of Ivaldi and McCullough (2001), finds modest cost complementarities between train operations and infrastructure ownership for US Class I railroads. A study by Bitzan (2000) that uses much more aggregated output data finds somewhat larger complementarities.

One of the most important issues regarding scope economies in rail is that of the danger of congestion and confusion when more than one train company operates on the track.[15] In one sense, rail is like telecommunications and unlike electricity in this respect: a particular train or a particular call must arrive at a particular destination for a transaction to be complete, while it makes no difference which company generated the particular electrons that flow to my computer when I turn it on. On the other hand, rail has its own aspects that separate it from these other two sectors: electrons and telephone connections can be switched and routed quickly and automatically and impersonally, while different trains are out there on the track in real time, and there are serious consequences if they try to occupy the same space at the same time. Both factors, of course, argue in favor of very close coordination of P and N operations in rail, which in turn argues at least for high quality telecommunications and information systems and perhaps for vertical integration.[16]

Beyond these points, the evidence suggests several lessons. First, there is plenty of experience, especially in the UK and the US, with one train company running its trains over another company's tracks.[17] Railroad managers tend to emphasize congestion and scheduling problems, but the more important problem when arrangements such as this are long-lived may be the preservation of incentives for the host railroad to maintain, improve, and extend the track.[18] Second, it is clear that in addition to the technical systems just mentioned, track sharing requires both a powerful and experienced regulatory body and a legal system that clearly enforces property rights. Again, what works in the UK may not work so well in Chad. Finally, although it may be too early to evaluate the long-term success or failure of the UK experiment, it is undeniable that the first five years of experience with vertical separation there has been one of a great deal

[15] Office of the Rail Regulator (1999a).

[16] One reason that the vertical unbundling model was not the model chosen for rail restructuring in Mexico was the judgment of policy makers that it "requires more and better infrastructure, such as signaling, freightyards, switching equipment and others, which the Mexican railroad system was lacking." Garc? a de Alba (2000).

[17] For the UK, see the section on "running powers" in Simmons and Biddle (1997). For the US, see Pinkepank (1979).

[18] Wilner (1998). In the UK, the Financial Times (July 17 2001) reports that "the government's new railway policy was thrown into doubt at its launch on Monday when the gibbest train operator warned that Railtrack could not afford to carry out even small infrastructure projects." In addition, the early UK experience has revealed an unexpected problem with incentives to invest in rolling stock (Affuso and Newbery [2001]).

of confusion, expense, accidents, and litigation.[19] Coordination of multiple train-operating companies over a single track -- as a fact of day-to-day life for the entire system, rather than an occasional convenience or regulatory requirement -- appears not to be as easy as some may have thought.

2. Economies of Scale. On this issue the literature is clearer. We must first differentiate between economies of *density* -- less than proportional increases in cost as more traffic is run over an existing set of track -- and economies of *system size* -- less than proportional increases in cost as more traffic is run over an enlarged track system. It is the former, economies of density, that concerns us here, especially given the modern paucity of new railroad line construction.

[19] Office of the Rail Regulator (1999b); Winsor (2001a and 2001b). The *Financial Times* (June 26 2001) describes a "conference of industry leaders ... aimed at rebuilding confidence" that "descended into a series of bitter charges and counter charges over service chaos, financial problems, and public outrage." An earlier *FT* story (June 4, 2001) reports that "More than 300 people are employed by railway companies to argue among themselves about who is to blame for late trains and who will pay .... The high cost attached to delaying trains has been linked to a rise in unsafe working practices and a decline in maintenance standards."

There is a consensus among analysts that most modern railroads operate in a region of economies of density. The results of Ivaldi and McCullough (2001) -- who also present a summary of the results of others -- are representative: they find returns to density at their sample means of 1.65, meaning that if all outputs are doubled, costs (including track maintenance costs) increase 65 percent. (Other studies that they cite find economies of density in the range of 1.31 to 1.92.) They conclude that "even if railroads were separated into operational and infrastructure entities, the firms would still experience operational returns to density and (like airlines) would enjoy large market shares. ... An open access regime would not necessarily lead to competitive outcomes."[20] Freebairn (1998) reaches the same conclusion in his study of Australian railroads:

> Much of the rationale under competition policy for vertical separation of the railways is to introduce competition in the train operating component. Given likely scale economies associated with maintaining a range of services, with marketing, and the size of trains relative to current and prospective demands, it seems likely that a few operators, rather than many, will dominate most lines, and in many of the intrastate lines there may be just one train operator.[21]

These results accord with the experience thus far. In those countries which have allowed some version of competitive track access -- the UK, Sweden, most recently the Czech Republic -- whether this has been accompanied by complete vertical separation of track owner from train operator or not, there has been very little entry observed into freight train operation.[22] What entry there has been has mostly been on the part of large shippers operating trains to ship their own goods -- a way for these shippers to keep rail costs down, but not (yet, anyway) a way to provide competitive service to shippers overall.

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[20] Similar conclusions are reported in the surveys of Waters (1985), at 119; Parry (1997), at 88; and Savignat and Nash (1999), at 211.

[21] Similar thinking supported the decision by Mexican reformers not to impose the vertical unbundling model on the railway. See Garc? a de Alba (2000).

[22] See, e.g., Bradshaw (1997), Wilner (1998), and OECD (2001a).

We should also note that, in spite of (arguably) showing the technological characteristics of natural monopoly with regard to density, railroads may face strong competition from road haulers, especially over shorter distance hauls (say, 500 km or less).[23] This is another reason why, especially in a small country, opening up the railroad to competing trains may offer few competitive benefits: the railroad's behavior may be constrained by truck competition for much or most of its traffic already. To the extent that multinational train operation develops, geographic markets become correspondingly larger and this constraint may not bind. This is one rationale behind EU Directive 91/440. A similar initiative is underway in southern Africa, where the Trans Africa Railway Corporation, a joint venture of two entrepreneurs with the South African Infrastructure Fund and a subsidiary of the South African railway Spoornet, is now offering direct rail service from Johannesburg to Kampala via Dar es Salaam.[24]

3. Ability to detect and prevent discrimination. In the case of railroads, the third and fourth points may be dealt with more quickly. In terms of discrimination in track charges, it is easier to monitor these charges in the railroad sector than network charges in electricity or telecommunications, as the number of transactions is almost infinitely smaller in the former.

This carries over to discrimination based on service quality as well. An enterprise controlling the track and operating trains can undoubtedly give itself important competitive advantages vis-a-vis other train operators, especially regarding access to the track at times of peak demand (for example, at times when passenger trains are on the track as well). But this process does not appear to be particularly subtle. There are plenty of examples where competing train operators in the US have created a neutral dispatching entity for scheduling trains that are for one reason or another using a common track.[25] If these competing train operators each have their own track, so that each depends on the other for cooperation, bilateral or multilateral negotiations can probably be counted on to yield an acceptable outcome. If only one of the train operators has its own track, however, the efficacy of this solution is going to depend strongly on the abilities of the regulator -- both the technical capabilities of diagnosing the issues and the legal capabilities of enforcing its orders.

4. Consequences of successful discrimination. In terms of the price of access, the cost of the network as a percentage of total delivered service cost is undoubtedly higher for rail than it is for electricity -- on the order of fifteen to twenty percent versus five to ten percent, based on industry-wide financial accounts. Thus a given percentage overcharge for network usage will have more impact on the price of the final rail service than on that of the final electricity service. The same is likely true for rail versus telecommunications: the percentage of final price attributable to network cost in the latter must vary a great deal by service, but certainly over time the "value" component of "value added" services must be increasing.

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[23] Pittman (1990).

[24] Robertson (1999); Kigotho (2001).

[25] Pinkepank (1979).

Regarding other terms of access, the opposite seems more likely to be the case. Some railroad freight traffic is time-sensitive, but most is not; unless the system of roads is severely inadequate, most time-sensitive cargoes move by truck. Where the traffic is not time-sensitive, discrimination in service quality is unlikely to be a major barrier to competition.

In summary, the rail sector is one where on-track competition between integrated and unintegrated train operators may be feasible, in those situations where regulatory and legal institutions are strong enough to prevent discrimination. However, because of both economies of density and intermodal competition, it seems unlikely that the benefits of on-track competition will be very great, except perhaps for the largest shippers. Such benefits hardly seem worth the cost of complete vertical separation, if and where that would be required to achieve them. (If the largest shippers may be provided with more competitive outcomes *without* imposing vertical separation on the overall system, this seems likely to be quite beneficial and worthwhile.) Thus the "vertically integrated monopoly" solution -- again, perhaps with an exception made for large shippers carrying their own freight -- may be the best outcome in many countries.

2.2. Electricity

Commercial electricity supply began in the late 19th century in the US, the UK, and elsewhere with small, localized, and integrated enterprises, some privately owned and some municipally owned.[26] In these early days of the industry, economies of scale were small and long-distance transmission impractical. A large share of industrial electricity use was supplied by self-generation -- over 80 percent in Germany as late as 1913, for example.

The early 20th century brought technological developments that both increased dramatically the efficient scale of generation plants and made economically feasible long-distance electricity transmission. The results were different in different countries. In the US, financial manipulation and stock-market speculation led to a national system largely in the hands of a few holding companies, until the stock market crash of 1929. Reaction to these abuses led to the enactment of the Public Utility Holding Company Act of 1935, and the result was a system of local and regional integrated monopolies, connected by a long-distance transmission grid which allowed for some balancing of regional disparities in supply and demand. Increasing scale economies in generation and increasing long-distance transmission capabilities in the period following World War II led to pressures for further consolidation and rationalization, but the federal system of governance, with its largely state-based regulatory apparatus, caused movement in this direction to be slow. (A similar federal system led to a similar outcome in Germany.) Significant changes appeared only in the 1990s, with state-level restructuring and unbundling initiatives coincident with an increase in merger and restructuring activity. By the turn of the century, a large share of the old US electricity companies had 1) vertically disintegrated, by selling some or all of their generation assets to merchant companies, 2) maintained their transmission and distribution activities, and 3) horizontally integrated with other transmission

[26] The following discussion is based on Kahn (1971) and Newbery (1994a and 1994b).

and distribution companies.

In the UK, significant interregional flows of power began with the creation of the Central Electricity Board and a national grid in the late 1920s. Unlike in the US, however, local integrated suppliers remained largely small and fragmented, and calls for amalgamation and rationalization went largely unheeded until the Labour Government nationalized the entire sector in 1947 as the Central Electricity Generating Board, a generation and transmission monopoly. Unfortunately the CEGB proved to be subject to the same bureaucratic sclerosis and political pressures as other nationalized enterprises in the UK and elsewhere, and the industry was privatized by Margaret Thatcher's Conservative government in 1989, with two fossil fuel generating enterprises (PowerGen and National Power), one nuclear generating enterprise, and some importers all selling power through the National Grid Company.

1. Economies of Scope. It seems very likely that, for all the technological changes in the electricity sector in the past few decades, there remain significant economies of scope between the generation and transmission stages of this sector. This is a sector probably more intimately interconnected technologically than any other infrastructure sector, a sector where demand must equal supply at each moment and a failure at any point in the system can have significant repercussions throughout the system. As Joskow (1997) emphasizes,

> The transmission system is not simply a transportation that moves power from individual generating stations to demand centers, but a complex "coordination" system that integrates a large number of generating facilities dispersed over wide geographic areas to provide a reliable flow of electricity to dispersed demand nodes while adhering to tight physical requirements to maintain network frequency, voltage, and stability.

Newbery (1994a) makes a similar point:

> The problem here is that the grid offers a variety of different services -- transmission to customers, access to insurance against power failure, freedom to schedule maintenance -- whose costs are jointly determined and which vary over space and time. Efficiently pricing these services, and at the same time giving the right price signals for investment decisions (for grid expansion, plant location and customer location), is inherently difficult.

Kaserman and Mayo (1991), using US data from 1981, find economies in the range of 10 percent for the integration of the generation stage with a combined transmission and distribution stage, while Hayashi, Goo, and Chamberlain (1997), using US data from 1983 through 1987 and (arguably) a superior methodology, find economies in the 13 to 16 percent range. Lee (1995), using US data from 1990 and a similar methodology to Hayashi, Goo, and Chamberlain, finds efficiency losses in the range of 4 percent when generation is separated from other stages. Kwoka (1996) finds significant economies of scope in the US, though Sinclair (1998) claims that Kwoka's methodology biases the results in that direction. Nevertheless it is the case that a number of countries, including England and Wales, Norway, and Argentina, have

completely separated generation from transmission in their electricity sectors.[27] Kaserman and Mayo (1991) note that as of a decade ago there was already huge variation in the degree of vertical integration in the US electricity sector, with some complete vertical separation and, among integrated enterprises, a range of the ratio of electricity generated to electricity distributed of 0.13 to 345.

[27] Newbery (1994a); Heller and McCubbins (1996); Joskow (1997).

2. Economies of scale. There is no dispute now that the introduction of electricity generation by combined-cycle generating technology (CCGT) has, at current gas prices, rendered electricity generation not a natural monopoly (if indeed it was before that). Newbery (1994b) notes that "the development of CCGT sets of 300-500 MW means that even small countries can now contemplate a variety of competing generating contracts." There is clearly more room here for a competitive P stage than in, say, railroads. It is true that even in the electricity sector the technical constraints of long-distance transmission will sometimes keep geographic markets sufficiently small that only a few generating plants may be supported.[28] However, technological developments are working gradually to ease these constraints, thus making geographic markets gradually larger.[29] Furthermore, as economies grow, electricity demand increases, and the scope for competition increases correspondingly. The same is true if and as cross-border trading in electricity increases, a likely prospect in Eastern Europe and the Former Soviet Union over the next decade.[30] Finally, a special determinant of the potential for P competition in the electricity sector is the current generation mix in a particular country: large supplies of low-marginal-cost hydro and/or nuclear power may make CCGT plants less competitive.

The failure to achieve attainable levels of competition in generation when restructuring the electricity sector is one of the most serious criticisms of the worldwide infrastructure reform project. The original UK decision to create only two conventional fuel generation enterprises was widely seen early on as inadequate, with accusations of anticompetitive supply restrictions by PowerGen and National Power in the winters of both 1996-97 and 1997-98. Divestitures were ordered by the regulator in 1996 and again in 1999, but calls for further divestitures and restructuring continue. Spain, Sweden, Italy, and the Netherlands have all chosen to permit a high level of market power in their restructured generation markets.[31]

3. Ability to detect and prevent discrimination. It is much more difficult for regulators to detect and prevent discrimination against unintegrated producers of P by integrated producers of both P and N in the electricity sector than in the railroad sector. This problem was explicitly recognized by the Federal Energy Regulatory Commission in the US when it issued its Open Access Rule, Order 888, in 1996:

The inherent characteristics of monopolists make it inevitable that they will act in their own self-

[28] Green and Newbery (1992); Newbery (1994a).

[29] FERC (1988).

[30] Spiller (1994) argues that "Unless governments prohibit imports of energy, as the Eastern and Central European electricity companies become privatised or semi-privatised, they will find it profitable to enter into contracts with other generators with lower costs. In the United States contracts are struck among suppliers at great distances from one another. California imports from Canada and the Midwest. The private companies will have the incentive to trade unless the governments have a policy disallowing such contracts."

[31] Day and Bunn (2001). Similar concerns have been expressed as concentration in US generation markets has increased. See Trebing (2000).

interest to the detriment of others by refusing transmission and/or providing inferior transmission to competitors in the bulk power markets to favor their own generation, and it is our duty to eradicate unduly discriminatory practices.[32]

[32] FERC (1996), at 31,682.

Whether even in the US regulators have the ability to prevent these practices is, however, quite doubtful. Unintegrated generating enterprises continue to complain about the regulator's inability to prevent abuses such as the following: a) the accurate calculation and timely posting of the amount of transmission capacity available on the system, b) superior access to transmission system information for employees in the P stage of the integrated enterprise, c) greater flexibility and otherwise favorable treatment for the integrated P producer vis-a-vis unintegrated P producers, and d) the discriminatory provision of line loading relief, which may result in the integrated P producer's supply being considered more reliable by customers than that of unintegrated P producers.[33] At the end of 1999, FERC sought to address this problem with Order 2000, which encouraged the private sector to create "regional transmission organizations" (RTOs) that would schedule transmission on a nondiscriminatory basis. Similarly, by the end of 1999 FERC had approved the operation of five "independent system operators" (ISOs), another form of neutral dispatcher.

4. Consequences of successful discrimination. It is clear that these kinds of discriminatory actions can have a serious effect on competition, effectively eliminating some producers from some transactions for which they should be able to compete. Electricity can change in value dramatically from hour to hour. Timely, reliable service is crucial. Klas Ringskog (1994) provides an example from Chile:

> [Access to timely network information creates] an exclusive club that may use the information on the complete grid and the different demands placed on it to their own advantage. The smaller generators have alleged that the major company, through its control of the transmission system and through its dominance, has been able to limit the smaller generators' access to large customers. ... Small generators wanted to capture the contract with the state railways. In order to be able to supply large consumers, a generator must prove that it has the right to use the transmission net and the contract was lost. The same problem was encountered concerning supply to the metro in a major city.

Actions like these which reduce the ability of unintegrated generation enterprises to respond to demand flexibly and quickly, or to assure service under difficult circumstances, appear to offer the potential of creating much more serious barriers to the competitive process than similar barriers in, say, the railroad sector.

Trebing (2000) notes that FERC's decision not to require vertical separation between generation and transmission will force it

> to proceed on a case-by-case basis to determine if each RTO application complies with its general guidelines. This oversight will have to cover transmission and congestion pricing, new investment practices, deployment of ATC [available transmission capacity], and the multiple opportunities for exercising market power.

[33] FERC (1999), at 66-83.

If such regulatory intervention has been less than fully successful in economies like the US, with their long traditions of regulation, it seems that much less likely to be successful in countries with inexperienced regulators. The electricity sector may be one in which the benefits of P-stage competition and the difficulty of preventing discrimination by the N-stage monopolist will often combine to favor the vertical separation solution -- which has, as noted above, been the general direction of restructuring in the US.

2.3 Telecommunications

As in electricity, the provision of telecommunications services began as a local industry, with long-distance service technologically feasible only some years later.[34] In the US, AT&T used the original Bell patents to enforce essentially a monopoly on the provision of local telephone services until the patents expired in 1894, when many new providers entered various local geographic markets. (AT&T had focused on business customers, and many of these new entrants found their niche serving residential customers.) AT&T then developed and exploited the patents for long-distance telephony, which only gradually demonstrated itself as a superior alternative to the telegraph for business customers. As long-distance service became more widespread and thus more important, AT&T refused to interconnect its long-distance service with independent local service providers, thus weakening them either for competition or for takeover. By the early 1930s, AT&T accounted for over three-quarters of local service and virtually all long-distance service. Its local and intrastate operations had been subject to state regulation since the first two decades of the century, but its interstate operations were subject only to weak oversight by the Interstate Commerce Commission. More stringent federal regulation was imposed by the Communications Act of 1934.

[34] This paragraph relies largely on Gabel (1996) and White (1999). A valuable discussion of the historical experience in Europe is Wallsten (2001).

This broad situation changed very little until the 1950s, when developments in microwave technology made possible increasing bypass of the long-distance system by businesses setting up private connections. Eventually antitrust enforcers at the Department of Justice concluded that neither long-distance service, customer premises equipment, nor information services -- we do not consider the second and third stages further in this paper -- were natural monopolies, while local service was believed to remain so. The Department believed that state and federal regulators were unable to prevent AT&T from discriminating in favor of its subsidiary enterprises in these stages, thus effectively preventing the development of competition there. Its monopolization lawsuit against AT&T resulted in a consent decree that split the company into one lightly regulated long-distance provider (the surviving portion of AT&T) and seven regulated local and intrastate long-distance providers (the Bell Operating Companies, or "BOCs"). The BOCs were forbidden to provide any service besides exchange telecommunications within their service areas without advance permission from the court that enforced the decree.[35] This state of affairs in turn was twisted and turned by the forces of technological change (such as the development of cellular technology) but remained basically unchanged until the enactment of the Telecommunications Act of 1996, a close discussion of which is beyond the scope of this paper.[36]

The telecommunications sector is probably unique among the infrastructure sectors -- and certainly unique among those examined here -- in the degree to which it has undergone technological change over the past few decades. Many of the boundary lines between different stages of this sector, and between this sector and other sectors, have been blurred.[37] Structural issues such as the relationship between long-distance and local-service providers that were the primary focus of the litigation in U.S. v. AT&T have been joined by a variety of other issues, regarding cellular telephony, the internet, cable television, and so on.[38] We will touch upon some of these issues below, while maintaining our focus on the original issue, which has not gone away.[39]

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[35] For an excellent description of the case, its rationale, and its outcome, see Brennan (1987).

[36] For details, see Harris and Kraft (1997) or White (1999).

[37] See, for example, Berg and Tschirhart (1995) and Pupillo and Conte (1998). Brennan (1995) outlines the most important developments: "the digitization of wireline networks, explosion in data communications, development of switched wireless systems, and plunging prices for complementary computers and multimedia equipment." Kerf and Geradin (2000) argue that "the progressive erosion of technical and operational differences between different telecommunications services might weigh against decisions to impose separation between some activities as it increases the economies of scope which one company might derive from providing several telecommunications services."

[38] Reiffen, Schumann, and Ward (2000) test for both the benefits of integration and the harms of discrimination in the provision of wireline and cellular service.

[39] Borissova (2001) discusses some of these issues in the context of the progress made in telecommunications liberalization in the Visegràd countries.

1. Economies of scope. At this point -- and again, with continuing and rapid technological change -- it is not clear why there should be important scope economies between the provision of long-distance and local telephony. It is also not clear how helpful are attempts at econometric estimation of these economies that (inevitably) use data that are to differing degrees out of date. Nevertheless it is interesting that the most recent studies have not found strong scope economies. For example, Banker, Chang, and Majumbar (1998), using data for US local exchange companies (LECs) for the period 1988-92, find mostly insignificant economies of scope. Bloch, Madden, and Savage (2001), using Australian data for 1926-91, find no significant scope economies. Shin and Ying (1992), using data for US LECs for 1976-83, do not test directly for scope economies, but find no significant scale economies for firms offering the combined outputs. Sung and Gort (2000), using data for the US BOCs for the period 1951-91, find small economies of scope that diminish with firm size. And Gabel and Kennet (1994) craft an engineering/process model that finds scope economies in rural areas only, diminishing as customer density increases. The burden of proof would seem to be squarely upon those who would argue that economies of scope between long-distance and local service are of significant magnitude.

2. Economies of scale. One of the hopes of those restructuring the AT&T system in the US was that a competitive long-distance market would develop. This hope has been realized only to a limited extent. The market remains dominated by AT&T, MCI, and Sprint, though both AT&T's market share and concentration overall in the US long-distance market have gradually fallen since 1984. Prices have fallen along with concentration, but this appears to be an artifact of regulatory reductions in access charges; net of access charges, both real long-distance prices and the price/cost margins of long-distance providers have gradually increased since the market was opened.[40] Knittel (1997) attributes the apparent persistence of market power by long-distance providers to significant search costs and switching costs for customers. All of this would seem to suggest that the potential for large benefits from creating competition in the P stage of the telecommunications is only moderate, probably greater than in rail but less than in electricity.

However, there is a related issue that may dramatically change the nature of the calculations in the telecommunications sector. It is increasingly doubtful whether the local wireline exchange is any longer a natural monopoly. Certainly any incumbent wireline operator enjoys a large "first mover" advantage in its control of its existing network, but the advantages of cellular and PCS technologies have rendered these new technological entrants as much substitutes as complements to wireline service in many situations, and the fact that cable television lines already pass a high percentage of homes in many cities similarly renders their providers viable potential challengers to the wireline monopolist. (To be sure, cable TV is not an important factor for many poor and/or rural citizens of transition and developing economies, but cellular and PCS products have dramatically surpassed expectations in many such settings.) In fact, in countries where

[40] Knittel (1997); MacAvoy (1998). (See also Hsing and Mixon [1994].) However, Ennis (2001) suggests methodological problems behind these findings. His study of international long-distance rates finds a more complex relationship between concentration and price: decreased concentration (increased competition) results in reductions in price for the "flagship" plans chosen by price-conscious customers, but in increases in price for the basic, default plans. Like Knittel, Ennis suggests that search costs are a factor in his results.

cable providers are in the process of entering local telecommunications markets, one common complaint is that the local wireline provider may be prohibited by regulators from entering the cable television market.[41]

A recent study finds that of 190 US local markets ("local access and transport areas," or LATAs) examined, only eighteen have had no new facilities-based carriers entering since the enactment of the Telecommunications Act of 1996, and a corresponding eighteen have had ten or more entrants.[42] Spiller and Cardilli (1997) conclude that

> Once the right to interconnect is assured, local telecommunications do not constitute a natural monopoly as classically defined, as the average costs of serving a local exchange area do not increase [decrease?] appreciably once a quite small minimum efficient size is reached. To put it another way, almost the only important economy of system-wide scale in local exchange service is that of interconnection....

[41] The UK is one example. See Waverman and Sirel (1997).

[42] Zolnierek, Eisner, and Burton (2001). The authors find, as expected, that entry has been most frequent in high-density business districts.

This may be less true in transition and developing economies to the extent that lower demand levels result in lower output levels.[43] On the other hand, if transition and developing economies have lower telecommunications penetration rates than developed economies, this will reduce the network advantage of the incumbent wireline operator and increase the likelihood that a second wireline operator or a new wireless operator can develop its own local network of sufficient penetration to interconnect with the incumbent as an equal.[44]

3. Ability to detect and prevent discrimination. This brings us precisely to the issue: how well can "the right to interconnect" be assured? As noted above, this question was at the heart of *U.S. v. AT&T*. The Department of Justice argued that regulators were in practice unable to prevent AT&T from a) providing higher quality local connections to its own, vertically integrated long-distance supplier than it provided to competing long distance suppliers, and in other ways offering better service to customers of both products than to customers of local service only; b) providing higher quality service to customers who used the telephone equipment of the AT&T subsidiary Western Electric than to those using the equipment of competing suppliers; and c) attributing costs from its unregulated products to its local telephone service, thus gaining artificial competitive advantages in the unregulated markets.[45] According to Brennan (1995),

> The most notorious examples of discrimination ... involved denials, delays, and then degradation in the local telephone network connections AT&T provided to MCI and other IXCs [interexchange carriers] competing with its long-distance service. More blatant examples of using the regulatory process to "raise rivals' costs" probably could not be found. (footnotes omitted)

As the court appeared to be heading toward a finding in favor of the Department of Justice, AT&T reached agreement on a consent decree that imposed strict vertical separation between the local and long-distance markets.

Are these problems as important nearly twenty years later? Brennan (1995) argues that they are

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[43] Armstrong and Vickers (1996). This would be consistent with the results of Majumdar and Chang (1998), who find that small US LECs enjoy increasing returns to scale, but these returns are absent once firms reach the size of the BOCs.

[44] I thank Sean Ennis for suggesting this point.

[45] Brennan (1987); White (1999).

not. Writing before the passage of the Telecommunications Act of 1996, he suggests that these concerns have not vanished, but that they have become sufficiently manageable that vertical separation may no longer be the appropriate solution:

> It may be optimistic to conclude that the regulators can monitor discrimination and cross-subsidization to eliminate any risk of monopolistic abuses, but the nearly open invitation to engage in such abuses facing AT&T from the early 1950s to the late 1970s is no longer on the table.[46]

It is important to emphasize, however, that Brennan is describing the conditions in the US and perhaps some other advanced market economies. It seems doubtful that regulators in most transition and developing countries, even with technical assistance, can attain even the level of monitoring and deterrence that US regulators possessed when *U.S. v. AT&T* was brought. We will turn to this question presently.

4. Consequences of successful discrimination. Again, the reasoning behind U.S. v. AT&T was that discrimination was difficult or impossible to detect and prevent, and that such discrimination wreaked havoc on the ability of otherwise competitive markets to operate smoothly and efficiently.

As Brennan (1995) and others have noted, however, the extent of the potential for mischief by the local monopolist in such a situation depends crucially on the strength of its monopoly position. To the degree that local wireline service is less a natural monopoly than it was twenty years ago, the ability of the incumbent monopolist to do harm by discriminating against rivals in the competitive stages has been reduced. On the other hand, to the degree that incumbent wireline monopolists retain first mover advantages, especially in transition and developing economies, they retain the ability to use this monopoly to harm competition in related market stages.

It seems clear that new regulators in transition and developing economies will in general be unable to detect and prevent discrimination by vertically integrated monopolists in the telecommunications sector. As in the electricity sector, this may be seen as arguing in favor of the *U.S. v. AT&T* option of vertical separation: a regulated local wireline monopolist is not permitted to operate in a competitive long-distance market. This is in many ways an attractive option: there are plenty of multinational telecommunications enterprises that would seem to be likely entrants into both domestic and international long-distance service in these countries, and their access fees can help to support expansion and improvement of local service.

[46] Writing a few years *after* the enactment of the Telecommunications Act of 1996, Weisman and Williams (2001) examine the tradeoff between allowing integration between the local and long-distance markets and the ability of regulators to detect discrimination.

The technological innovation present in this sector suggests another option, however, an option that has been somewhat successful in developing countries as small as Guatemala and Chile: allowing competition between and among vertically integrated enterprises.[47] The secret behind the success stories of these two countries may be similar to the one described earlier as one factor behind the successful sharing of track by different railroad enterprises: if the incumbent wireline monopolist receives broadly similar benefits to interconnection with an entrant that the entrant receives from interconnection with the incumbent, the possibility of retaliation to discrimination may enforce equitable treatment. It is well known that such voluntarily negotiated terms of access among vertically integrated competitors may well not yield optimum results,[48] but we are in a world that is far from first-best here. In sectors where the natural monopoly assumption has been significantly weakened, this third restructuring option of vertical integration with competition may provide a "good enough" -- and, perhaps, quite dynamic -- outcome.

3. The Countries

The previous discussion has suggested several localized factors that are likely to be relevant in the evaluation of restructuring options in the railroad, electricity, and telecommunications (and other) sectors. Among the most important of these would seem to be the following:

- the capabilities of sectoral regulators (who in fact may not exist in particular countries);
- the effectiveness of the judicial system in enforcing regulatory orders; and
- the effectiveness of the telecommunications and information systems in the country (which, in conjunction with the size of the country, may determine the scope of the regulator's effective authority).

As very rough indicators of the first two of these factors, we will use the composite indicators of Government Effectiveness, the Regulatory Framework, and the Rule of Law calculated by Kaufmann, Kraay, and Zoido-Lobatón (1999a and 1999b) (hereinafter KKZL). KKZL summarize the content of these three indicators as follows:

- In "Government Effectiveness" we combine perceptions of the quality of public service provision, the quality of the bureaucracy, the competence of civil servants, the independence of the civil service from political pressures, and the credibility of the government's commitment to policies into a single grouping. The main focus of this index is on "inputs" required for the government to be able to produce and implement good policies.

[47] Spiller and Cardilli (1997). Cricelli, Gastaldi, and Levialdi (1999) also emphasize the benefits possible from competition among vertically integrated telecommunications providers.

[48] Laffont, Rey, and Tirole (1998); Carter and Wright (1999).

- "Regulatory Burden" ... is more focused on the policies themselves. It includes measures of the incidence of market-unfriendly policies such as price controls or inadequate bank supervision, as well as perceptions of the burdens imposed by excessive regulation in areas such as foreign trade and business development.

- In "Rule of Law" we include several indicators which measure the extent to which agents have confidence in and abide by the rules of society. These include perceptions of the incidence of both violent and non-violent crime, the effectiveness and predictability of the judiciary, and the enforceability of contracts. Together, these indicators measure the success of a society in developing an environment in which fair and predictable rules form the basis for economic and social interactions.

Table 1 shows the levels of these three indicators for the four countries under examination here, as well as values for the lowest and highest countries rated on each indicator.

Table 1. Composite Indicators of Governance Effectiveness

Indicator	Lowest country	Lithuania	Poland	Romania	Russia	Highest country
Government Effectiveness	-1.883 (Iraq)	0.127	0.674	-0.570	-0.595	2.082 (Singapore)
Regulatory Framework	-3.142 (Iraq)	0.089	0.565	0.199	-0.303	1.245 (Singapore)
Rule of Law	-2.153 (Dem. Rep. Of Congo)	0.180	0.538	-0.088	-0.722	1.996 (Sweden)

In addition to these broad factors, we will examine particular sectoral factors which may determine the degree of monopoly power of the N incumbent -- for example, the quality of the road network for rail, the existence of low-marginal-cost hydro or nuclear or imported power for electricity, the existing level of population coverage for telecommunications. As rough measures we use mainly the following:

- information on road density from the International Road Federation (2000),
- information on electricity generation from the Energy Information Agency of the US Department of Energy (2001), and
- information on telecommunications coverage from the International Telecommunications Union (2001).

Table 2 shows the levels of these measures for the four countries under examination here, along with those for selected other countries.

Table 2. Selected Infrastructure-Specific Factors Affecting Reform

Indicator	Lithuania	Poland	Romania	Russia	US	France	South Africa
Road Density (km/km2)	1.09	1.22	0.66	0.30	0.65	1.62	0.29
Nuclear and Hydro Electricity Generation (% of Total)	.822	.032	.462	.326	.274	.885	.079
Main Telephone Lines per 100 Inhabitants	32.11	28.24	17.46	21.67	67.30	58.02	12.53

Let us consider, then, how these factors might play out in the three infrastructure sectors under examination here in a very large country (Russia), a very small country (Lithuania), a medium-sized country that is relatively advanced on the transition path (Poland), and a medium-sized country that is not so advanced on the path (Romania).

3.1 Russia

The first central fact about Russia for our purposes is its size. The second is its devolution of governing authority to the oblasts: what Moscow says may or may not be what gets done. The KKLZ index of Government Effectiveness for Russia is -0.595, lowest of the four countries included in this study. The third is the lack of any tradition of market-style infrastructure regulation. The KKLZ index of the quality of the Regulatory Framework in Russia is -0.595, again the lowest of our four countries. The fourth is the absence, both current and historic, of the rule of law: an unfortunate legacy of centuries of autocratic rule. A Russian judge may or may not be corrupt, and may or may not act according to political orders, but there is certainly no tradition of an independent judiciary upholding the rights of citizens against government abuses. The KKLZ index of the Rule of Law in Russia is -0.722, again the lowest of our four countries. The fifth is the poor state of the overall national telecommunications system, which undoubtedly exacerbates the problems encountered by Moscow when it tries to impose its will. The telephone network penetration rate, at 21.7 main lines per 100 inhabitants in 2000, is not bad for a formerly socialist economy but still only about one-third of the rates for the UK (56.7 per 100) or the US (67.3 per 100). Furthermore, penetration must be much lower in Asian than in European Russia.

Finally, there are sector-specific facts. The road system is not very good in European Russia and dreadful outside it; the density of the overall network (km roads/km2 land area) is only 0.30, the lowest among our four countries. As the road density in European Russia is probably somewhere in the range of those of Poland (1.22) or Romania (0.66), density in the vast Asiatic steppes must be closer to those of Kyrgyzstan (0.10) and Kazakhstan (.04). Such roads as there are are rarely more than two lanes and are often in poor condition. Electricity is mostly generated by thermal sources (67 percent), so competition from new gas generation plants may be feasible.

What does all this suggest for the three sectors under examination here? The railroad sector will continue to have market power over shippers for the foreseeable future: shipment distances are long -- in part because decisions concerning enterprise locations were typically made using non-economic criteria -- and the roads are so poor that many commodities that would travel by truck in the West must travel by rail in Russia. The distances of haul are so great that unexhausted economies of density will likely prevent meaningful competition among competing train operators in most regions, and the poor quality of the regulatory and telecommunications systems mean that it would be very difficult to detect and prevent discrimination against unintegrated train operators by an integrated track and train operator. One legacy of the Socialist system of production organization is "giantism", the existence of huge, vertically integrated plants, much larger than their counterparts in the West.

All of this suggests that a variant of the Mexican rail reorganization system may be appropriate for Russia: the creation of a number of *vertically integrated regional monopolists*, connected at cities and/or large production centers to provide source competition at those points.[49] Large shippers in Russia usually have internal rail systems and own their own rolling stock, so a limited amount of self haulage, as is contemplated but not yet in place in Mexico, may be an appropriate check on the market power of the integrated railroads. It is extremely doubtful that the regulatory system and the rule of law are of sufficiently high quality to enforce the option of vertical restructuring with competition, and the unlikelihood of much train competition renders the vertical separation option unattractive. A system of regional integrated monopolists seems the best outcome for the time being.

With regard to electricity, Russia has abundant supplies of cheap natural gas, and hydro and nuclear generation account for only about one-third of the country's electricity supplies, so, as noted above, it seems likely that a competition generation market could be created. Again, however, with a very weak regulatory and judicial system, it is probably quite unlikely that discrimination by an integrated enterprise against unintegrated generators could be successfully prevented. This would seem to argue for the *vertical separation* model in the Russian electricity sector.

[49] See Garcia de Alba (2000) for a detailed discussion of the reorganized Mexican railway system. I discuss the benefits of such a system for Russia in greater detail in Pittman (2000).

In telecommunications, the poor penetration rate through most of the country, and only moderate penetration rates even in more advanced European Russia, suggest that a privatized incumbent wireline operator will not have a large first mover advantage over later, more technologically advanced entrants. If and as such entrants are allowed to offer basic service to businesses and individuals desiring value added services such as high-speed internet connections, the local wireline company will need connection to these new networks as much as the new networks will need access to the local wireline network. This suggests that bilateral negotiation may be a better regulator of competition than would a very imperfect telecommunications regulator, and that the *vertical integration with competition* model may be the best of imperfect restructuring choices. If this model is chosen, of course, any areas where the incumbent enjoys a significant advantage may require the regulatory body to attempt to enforce equitable, nondiscriminatory access conditions.

3.2 Lithuania

In contrast to Russia, the first central fact for our purposes about Lithuania is its small size: at 25,174 square miles, smaller than any of the EU countries except for Belgium (11,779 sq. mi.) and the Netherlands (13,433 sq. mi.). KKLZ governance indicators are in the middle range of our four countries and indeed in the middle range of the KKLZ rankings. Lithuania's years of interwar independence and longstanding connection with Poland provide it with a much stronger heritage of constitutional government and judicial power and independence than were the post-socialist inheritance in Russia. Road density and telephone penetration are high for Eastern Europe, and in fact the former is better than some EU countries -- Greece, Italy, Portugal, and Spain all have road penetration below 1 km per sq. km. Lithuania is a special case regarding electricity; its 82 percent share for nuclear power ranks it, along with France, among the highest in the world.

In the rail sector, Lithuania's high road density suggests that intermodal competition to a rail monopolist should be fairly effective. Lithuania's small size suggests further that many shippers captive to rail will be shipping beyond Lithuania's borders, but a monopoly Lithuanian railroad would still control the "monopoly leg" of the journey, and thus, absent international rail rate regulation, still likely to be able to charge a monopoly price. Should Lithuania eventually join the EU, it will be required to allow some kind of international train operators to operate over its track system, but whether this EU requirement will extend to providing competitive train operations to local shippers is not yet clear. In any case, the rail sector is in the process of being opened up for competition, and several train operators are expected to enter the market in 2001. Eventually, though not immediately, a vertical separation model is anticipated.

As I have suggested above, however, it is not at all clear that the vertical separation model is the best one for the rail sector, especially in a small country. Economies of density in train operation may preclude the development of effective competition among train operators. The UK experience so far is not encouraging. In the long run I suspect that the *vertically integrated monopolist* model is more appropriate for Lithuania's rail sector.

Let us add two qualifications, however. As I suggested for Russia earlier, it may be that a useful amendment to this model would be for large captive shippers to be allowed to operate trains over the track to serve their own needs. Also as in Russia, it seems possible that some source competition could be created here in the longer term. Two of Lithuania's four largest cities, Vilnius and Siauliai, are relatively near international borders, and are connected by direct rail lines to Minsk and Riga, respectively. One possible rail reform plan for Lithuania might be to create a vertically integrated monopolist for most of the country, but, in conjunction with neighboring countries, to seek to inject source competition by creating independent international railroad companies serving, among other locations, the Vilnius-Minsk corridor and the Siauliai-Riga corridor.

With regard to electricity, Lithuania's heavy reliance on power generated by the nuclear power plant at Ignalina makes it unlikely that new gas generating plants, or any other new sources, could result in competitive generation markets in the near future. Furthermore, even if EU-inspired plans to close the Chernobyl-style reactor at Ignalina by 2005 come to fruition,[50] the country has adequate fossil fuel generation capacity to serve its own needs.[51] In the longer term, both environmental concerns and the availability of cheap natural gas supplies may dictate the creation of a new electricity generation sector *ab initio*. In this case a good deal of foreign investment is likely to be required, and the protection to investors against discrimination offered by the *vertical separation* model would seem to have much to offer.

The telecommunications sector raises more difficult questions. Telephone density in Lithuania is higher than in any of the other four countries we examine here, but is firmly in the middle of the pack for Central and Eastern Europe as a whole, where coverage ranges from lows of 10.3 main lines per hundred in Bosnia and 13.3 in Moldova to a high of 37.8 in both the Czech Republic and Slovenia. The existing regulatory framework is already showing signs of inadequacy, as the incumbent wireline monopolist has refused to provide the Lithuanian Competition Council with the cost information that it needs to investigate charges of favoritism with regard to the incumbent's subsidiary internet services provider vis-a-vis non-integrated internet service providers. (As I write, this case is before the courts.)

With regard to coverage, one could say that the glass is half full, and that existing coverage is low enough that a technologically advanced entrant would have the leverage to force a bilateral nondiscriminatory access agreement on the incumbent wireline provider, or that the glass is half empty, and that the incumbent would refuse nondiscriminatory access unless a regulator so mandated (or attempted to so mandate). But Lithuania has no experience at all with a telecommunications regulator as yet, which suggests that discrimination will be difficult to prevent. This is probably a country where a *U.S. v. AT&T*-style *vertical separation* model is appropriate, at least for the short term, so that the incumbent loses the

[50] Business Central Europe (2001).

[51] The nuclear plant is not vertically integrated, but the remaining twenty percent of Lithuanian electricity that is generated in thermal plants is mostly part of a system that is integrated forward into the transmission and distribution monopolies. Currently the country's generation surplus is exported, largely to Belarus.

incentive to discriminate and P stages such as long distance and internet service provision may enjoy the benefits of full competition. As regulators gain sophistication and as P stage entrants gain market share, a Chilean-style simultaneous opening of P and N stages may then be appropriate.

3.3 Romania

Romania comes to the table with the least helpful historical inheritance of these four countries. The break in 1989 was not the complete break with the communist past that took place in Lithuania, Poland, and Russia. The pre-1989 dictatorship of Nicolae Ceausescu was closer in spirit to Stalin's than to Brezhnev's USSR, and closer in economic organization to Stalin's or Brezhnev's central planning than to the late experiments in socialist liberalization of Hungary, Poland, and the USSR. The interwar period of democracy was marred by a strong fascist and anti-semitic party, the Iron Guard. And the eighteenth and nineteenth century periods of (variously) Ottoman and Russian rule left a legacy of corruption and dependence.[52] What is surprising in the KKLZ indicators is not that Romania does badly but that it does not do worse: only its measure for Government Effectiveness is in the same dramatically bad area as that of Russia, while its measures for Regulatory Framework and Rule of Law are both in the same neighborhood as that of Lithuania.[53] As in Russia, the privatization program to date has been consistently mired in scandal.

In terms of other indicators, the Romanian road system is bad, probably worse than the Road Density data would indicate since the roads are in bad repair and almost never more than two lanes. Using another common measure of road network quality, the km of paved roads per million population, Romania

[52] See, *e.g.*, Stan (2000a and 2000b) on the post-1989 period; Manea (1992), Stan (1995), and Deletant (1999) on the communist period; Cretzianu (1998) and Sebastian (2000) on the interwar years; and Florescu (1997) and Constantinesco (1998) on the pre-20th century history. A fictional treatment of the interwar years, interesting partly because its author played an important role in those years, is Eliade (1978).

[53] A recent, alternative source is less optimistic regarding the rule of law: "A majority of the Romanians distrust the judiciary, regard the laws as unjust and their application as unfair. 83% of Romanians consider that we cannot speak of the rule of law in Romania, as the laws are neither enforced by state agencies, nor abided by citizens." Romanian Academic Society (2001).

ranks last among the four countries examined here.[54] Both hydro and nuclear generation are important components of its electricity supply, though far less important than in Lithuania. Telephone coverage is the poorest among these countries.

[54] The levels are as follows: Lithuania, 14,348; Poland, 6336; Russia, 5087; Romania, 3421. Winston [2000] notes that "one obvious reason for the inattention to road infrastructure is that until [the 1990s], regulation forced all surface transport with a journey greater than 50 kilometers to use rail."

Romania's inadequate road system means that the Romanian railroad sector plays an unusually important role in both freight and passenger transport, and that shippers will often lack competitive intermodal alternatives to rail. (Water shipments, both by river and the Black Sea, account for a large share of Romanian freight shipments, but these are more often complements to than substitutes for rail shipments.) Early reform measures have divided the rail sector into five separate (and still publicly owned) enterprises, comprising freight, passenger, track, legal/financial, and "assets". Apparently there is some desire to implement the vertical separation model, but so far, even with only two train operators and with both of them belonging the same enterprise as the track operator, there have been frequent disputes over access prices and other terms.[55] It seems very doubtful that Romania has, or will have in the foreseeable future, the regulatory capability to implement the vertical separation model, and it is not at all clear that competition would result from implementation.

Romania and Poland are both probably too small to adopt a full-fledged source competition model along the lines of Mexico's, but something like what I have suggested above for Lithuania might be viable: an *integrated monopoly* serving most of the country, but with competing lines heading into neighboring countries from regional centers such as Bucharest, Timi_oara, Cluj, and/or Ia_i. This could be coupled with the ability of large captive shippers to operate trains to service their own needs in interior locations such as Ploie_ti, Craiova, and Bra_ov. Gala_i and Constan_a both have excellent water access, so most shippers there require no protection.

An alternative solution for medium-sized countries such as Romania and Poland that are seeking EU membership and so will be allowing some competitive train access anyway would be to implement the full *vertical separation with competition* model. True, this model has not yet been shown able to create significant competition in freight haulage, but freight transport in both Romania and Poland is more bulk shipment intensive than in other countries where this has been attempted (especially the UK), and this, combined with the poor Romanian road system, means that shippers will be more dependent on rail and so willing to pay higher rates, so there may be some reason for hope. However, given both the poor governance record in Romania and the unlikelihood of significant train competition because of economies of density, I am inclined to favor the amended Mexican model outlined in the previous paragraph.

[55] Winston (2000).

In the electricity sector, the proportion of generation accounted for by thermal sources -- still over fifty percent -- makes it appear likely that gas generation could be a possible source of competition. The poor governance record and regulatory capabilities would then seem to argue for the vertical separation model. There are three problems with that model in this situation, however.[56] The first is that Romania currently possesses a great deal of excess capacity in its electricity sector -- and will possess more if deferred maintenance on existing coal-fired plants is ever made good -- so that entry by new generating companies is not likely any time soon. The second is that Romania probably lacks the technical regulatory capabilities to administer the day-ahead or real-time spot markets that account for much of the gains from creating competition in wholesale energy markets. The third is that there is further nuclear generation capacity under construction at Cernavoda, a legacy of the Ceaucescu era preference for autarky. It is unlikely that this plant will ever be completed even in its scaled down version (from fourteen reactors down to five), but one reactor at least seems likely to be completed.[57] On the other hand, there is no obvious reason why the 26 coal-fired plants could not be restructured into a competitive thermal generation stage.

This seems a very close call. On balance, the *vertical monopoly* model probably makes the most sense for Romanian electricity for the time being. The likely costs and uncertainties associated with vertical restructuring are simply unlikely to be exceeded by sufficient benefits to justify them. However, a procompetitive amendment to this model worth considering might be along the lines of the second alternative suggested for the railroad. Since many of the Romanian population centers are relatively near international borders -- I mentioned Bucharest, Timi_oara, Cluj, and Ia_i above, and one could add Craiova, Arad, Oradea, and Satu Mare as lacking the rail connections but potentially having the electricity generation connections -- source competition from integrated international companies could in principal supply at least one alternative generation source to a large percentage of the population, and more if the international transmission line is forced by regulators to carry the power of multiple generating enterprises.

Finally, Romania's telecommunications systems coverage is poor even for a transition economy: in Europe, only the above-mentioned Bosnia and Moldova rank lower.[58] Already the issue of interconnection prices between the incumbent wireline monopolist Rom Telecom and the two mobile radio operators that have been allowed to enter has been a difficult one, with neither the regulatory National Agency for Communications and Informatics nor the Competition Office able to play much of a role.[59] This suggests that, as in Russia, the model of *vertical integration with competition* may be the best solution: new

[56] All three are well described in Wolak (2000).

[57] Newbery (2000).

[58] "By most measures, the Romanian telephone system at the time reform began was near the bottom for the region. Penetration of the system was low, the waiting time for service was nearly five years, call completion rates were low, and line faults were high." Noll (2000).

[59] Noll (2000).

market entrants offering advanced technology may be able quickly to build up a network of subscribers that the incumbent wireline operator will desire interconnection with, so that bilateral negotiations among integrated suppliers may do a better job than regulation at preventing discrimination in access terms. Noll (2000) notes that already "business customers are being offered a growing array of alternative telecommunications services for data transmission activities and private networks." My understanding is that the government has committed to opening up the market to vertically integrated competitors in 2003.

3.4 Poland

Poland is about the same size as Romania but came to the transition with a much superior heritage of governance, including pre-1989 steps toward economic liberalization, a more democratic interwar experience, and a long history of monarchies limited by parliaments. It has been a leader among the post-socialist countries in infrastructure and regulatory reform, though there is still much to do. Poland ranks highest among our four countries on all three KKLZ indicators and in fact is not far from many EU member countries on those three scales.[60] Similarly, Poland has the highest road density of the four countries examined here, and the second highest telephone penetration rate. With a history of a large and important coal sector, its electricity is almost entirely thermal generated.

Poland has already begun railroad reforms that would separate ownership of infrastructure and operations and attempt to create competition among train operating enterprises. Its position as an applicant for EU membership and its location on important transport corridors between the EU and Eastern Europe and Asia dictated that it would take some steps in this direction in any case. If any post-socialist country has the regulatory sophistication to make either a system of vertical separation or a system of vertical integration with competition work in the rail sector, it is probably Poland.

As I have discussed throughout this paper, there are reasons, both analytical and from experience, to be skeptical that either model will bring competitive benefits worth the costs of regulation and (in the case of vertical separation) the loss of scope economies. Poland's coal sector will clearly become less important, not more important, as politically difficult decisions are made to close uneconomic mines.[61] In addition, Poland's wage structure is among the highest in the post-socialist world -- several multiples higher than Romania's or Russia's, somewhat higher than Lithuania's -- which also suggests a future of higher value added products that are not so rail dependent.[62] Thus domestic rail traffic, at least, seems likely to be stagnant for the foreseeable future, and this does not bode well for the development of multiple, competing

[60] For example, the Regulatory Framework indicator value for France is 0.713, for Belgium 0.794. Poland's indicator values for Government Effectiveness and Rule of Law are higher than those for Greece, which are respectively 0.560 and 0.496.

[61] See, e.g., *Business Central Europe* (2000).

[62] *Business Central Europe* (2001).

train companies. If the outcome of reform is bilateral monopoly, the game will certainly have not been worth the candle. On the other hand, if the outcome is an integrated quasi-monopoly whose market power is tempered by large shippers running their own trains, and/or by international train operating companies with the rights to serve local shippers, things certainly look better. If the new rail regulator is up to the task, Poland is a country where *vertical integration with competition* may have a chance to succeed in the rail sector.[63]

As electrical generation comes gradually less from Polish coal and more from Russian gas, the Polish generation sector has the potential to become competitively structured. Again, Poland's relative regulatory sophistication for this part of the world arguably makes the vertical integration with competition model potentially more workable than in the other three countries examined here. However, even in this country regulators are unlikely to be able to detect and prevent discrimination adequately, so that the *vertical separation* model would seem the most promising. As in Lithuania, this is especially the case to the extent that development of the gas generation sector will require significant foreign investment.

Telecommunications reform is another difficult call. Poland has had a telecommunications regulatory agency only since 2000, and the history of *de facto* regulation by the Polish Office of Competition and Consumer Protection is one of noncompliance and evasion by the incumbent wireline monopolist. According to an OECD report,

[63] Janusz Ordover and I argued this case, probably too strongly, in Ordover and Pittman (1994).

> The traditional telecom monopoly, TPSA, has been subject to several orders, and sometimes fines, for refusing to contract for joint billing, excessive lease charges, obstructing connection and cutting off operators to force them to take better terms or eliminate competitors, targeting new entrants' customers with special terms, tying and unjustified charges ... , and anticompetitive cross-subsidized tariff structures.[64]

Three new entrants have received licenses to offer wireline services, but it is unclear how effectively they can provide competition without much more effective regulation. The same is true with potential entrants into long-distance service: one consortium that includes Poland's power grid company PSE and another that includes that railroad PKP have been unable to reach agreement on access terms with TPSA, and the government has not intervened.[65] This may be a country, like Lithuania, where *vertical separation* is in order until competing wireless providers can build up customer networks of sufficient size that the wireline incumbent agrees to equitable access terms voluntarily. At that point, the market could be opened to competition among vertically integrated firms.

4. Conclusion

Table 3 summarizes the recommendations for restructuring that result from the analytical framework that I have suggested.

Table 3. Summary of Recommendations for Restructuring

Sector	Russia	Lithuania	Romania	Poland
Rail	vertically integrated monopolist(s)	vertically integrated monopolist	vertically integrated monopolist	vertical integration with competition
Electricity	vertical separation	vertical separation	vertically integrated monopolist	vertical separation
Telecommunications	vertical integration with competition	vertical separation	vertical integration with competition	vertical separation

[64] OECD (2001b).

[65] Bush and Spiro (2000).

In Section 2 of the paper, I suggested that different restructuring options might be more appropriate in different infrastructure sectors. In particular, I argued that the best model for the rail sector would often be that of the vertically integrated monopolist; for the electricity sector, vertical separation; and for the telecommunications sector, vertical integration with competition. In Section 3, I suggested that these general sectoral recommendations might change when applied to particular settings. Table 3 suggests that this is exactly the case. Poland may be a only country where the theorist's dream of vertical integration with competition in the rail sector is workable. Romania has so much excess thermal capacity that competitive entry in electricity generation seems unlikely any time soon. In both Lithuania and Poland, the incumbent wireline monopolist is probably too well entrenched for vertical integration with competition to be successful at creating competition in telecommunications.

I trust that it is obvious that I do not claim to have "solved" a controversy with any one of the twelve recommendations listed in Table 3. Each entry in the table -- not to mention potential recommendations for other sectors and other countries -- clearly merits detailed examination on its own, far beyond the few paragraphs devoted to it here. My purpose has been to suggest a broad approach to the issues and to use particular sectors and countries for illustrations of this approach. Competition is worth striving for, all the more so in countries where regulation is new and regulatory resources are scarce. What kind of competition is attainable in what circumstances is the difficult question.

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