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Abstract

Some private firms operating as common carriers or regulated utilities enjoy eminent domain powers in the U.S. The rationale resembles that for local governments; lower cost of assembling land for long distance electric transmission, gas and oil products pipelines, etc. Regulation theory, however, raises a question about possible inherent inefficiency of regulated firms' transmission route choices. Does eminent domain allow the firm to use inefficiently long indirect land corridors, inefficiently wide corridors, or by using higher value land when lower value land is available as an alternative? Using a rate-of-return regulation model of the firm's choice of its transmission system land route, this paper finds that corridor width may or may not exhibit an Averch-Johnson bias. The route selection results are more clear-cut; these firms follow the same Pareto rule that would be followed by an efficiency-oriented government when designating which land to take for a transmission route.

Keywords: Private eminent domain, public use, regulated firm

JEL Topic Codes: K11, R14, R38

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1 Introduction

Several U.S. states delegate eminent domain powers to private firms in the electric transmission, irrigation, or petroleum and gas pipeline industries. The federal government similarly grants eminent domain power to natural gas and petroleum products interstate pipeline firms. These industries are similar in that they are regulated as common carriers or public utilities. They are also similar in that their productive facilities–power transmission towers and lines, canals and aqueducts, or pipelines–require uninterrupted corridors of land. It is this last shared characteristic that provides an efficiency rationale for granting these private firms eminent domain powers as a means of minimizing strategic holdout problems when assembling large land tracts in the open market.

This paper examines one of the consequences of this practice of granting eminent domain power to these private firms. It studies the extent to which empowering a regulated firm to take land in the private market leads to inefficient land use. Regulation theory suggests that common carriers like those exercising eminent domain in the U.S. have incentives to use relatively more capital than is efficient–the well-known Averch-Johnson effect (Baumol and Klevorick, 1970). The question is whether allowing these firms to exercise eminent domain–which means that they are free to choose their preferred land routes–promotes similar inefficiencies in land use, creating incentives to use inefficiently large amounts of land (corridor width), select inefficiently long routes (corridor length), or take more valuable land when equivalent less valuable land is available (corridor value).

As common carriers, firms that enjoy eminent domain powers serve the public interest by meeting the demands of all users at regulated prices. They must generate sufficient product and–more importantly for the issue addressed here–deliver the product for distribution, sometimes over great distances. The process of obtaining the land corridors necessary for long-distance electric transmission systems or petroleum pipelines resembles the process of acquiring the land needed for a public highway. The efficiency rationale for granting these firms eminent domain powers is that reducing the transactions cost of acquiring an essential input lowers the product price required to sustain the rate-of-return regulated firm.[1] Accordingly, eminent domain powers in the hands of these firms translate into more efficient provision of these important goods and services.

If the intensity of public debate in several of the states delegating such powers to private firms is any indication, however, these eminent domain powers are granted somewhat reluctantly. This reluctance is partly a product of public angst over the notion that private firms hold resource allocation powers similar to those held and exercised by governments. The public highway analogy emphasizes the similarity of land assembly problems confronted by private firms and governments, but it also overlooks the fact that governments are more directly subject to the checks and balances of the electorate than are private firms. However, it is not clear whether or not local political influences increase or decrease efficiency when siting these types of facilities. While Fischel (2001) argues that some local governments have incentives to voluntarily take in undesirable economic activities like landfills, the main difference between those cases and high tension power transmission or pipeline corridors considered here is that landfills and similar activities bring in local jobs and tax revenues. The direct benefits of transmission or pipeline corridors to the locale's economic well-being, on the other hand, are negligible in comparison. The reluctance of a community to allow these transmission corridors within its jurisdiction is exacerbated by the fact that the economic benefits of these systems–the delivered electric power or gas or petroleum products–typically accrue to distant communities. With no local economic payoff and distant beneficiaries, we expect local governments to not willingly allow these land uses when their residents object to them, regardless of the overall efficiency implications.

Some of the public concern over private eminent domain is doubtlessly motivated by the perceived unfairness of highly visible takings cases reported in the popular press; it is troubling to many people to be reminded that it is not necessary to give

[1] Unrestricted route selection or facility siting is implicit in this discussion of private eminent domain powers. That is, while the regulatory authority has the power to decide what to include in the regulated firm's rate-base, the firm is free to choose the land route for its pipeline, power transmission lines, etc. Note that firms that do not have eminent domain powers can obtain land by having governments exercise condemnation on their behalf. But this makes the condemning governments partners in the route selection process.

consent to lose title to property. But this type of public dissatisfaction is not unique to cases of eminent domain exercised by private firms. It arises even when governments exercise eminent domain.

Equitable compensation is another concern raised in the popular debate over private eminent domain powers. Here, too, complaints about takings compensation apply equally to governments, since both firms and governments are constrained to compensate owners at fair market value. The equity problem arises in takings cases because most property owners are inframarginal in the land market. Property owners who are not willing to sell at current market price are enjoying some level of consumer surplus or subjective value above market value (the subjective value or surplus perhaps arising from an individual's long personal attachment to a particular property or from a business's long term efforts to build a customer base centered on its location). While courts interpret the "just compensation" required by the U.S. Constitution as the property's market value, compensation based on market value neglects the owner's forgone consumer surplus or idiosyncratic subjective value and in that sense does not fully compensate the owner for his or her loss. The individual owner's consumer surplus is not observable by third parties, however, which makes it impossible to include this value in the compensation rule; every owner facing eminent domain would have an incentive to over-state his subjective value of the property if it would increase his compensation. As a practical matter, "taking measuring costs into account, fair market value may be the best proxy for just compensation" (Miceli, 1997, 139). This concern over equitable compensation is endemic to the broader debate over takings in general and does not reflect an inherent weakness of private firm eminent domain over government eminent domain.[2]

This leads us to conclude that concerns about private firms exercising eminent domain do not really hinge upon the notions of involuntary property transfer or compensation. Instead, the question resolves to one of procedure, that is, defining "who" has the power to initiate condemnation–and whether or not it matters.

[2] In addition to equity concerns, the economics literature also examines how alternative compensation rules for eminent domain distort investment incentives, thereby affecting efficiency. See, for example, Blume, et al (1984), Fischel and Shapiro (1989), Miceli (1991), and Innes (1997).

This is the question addressed in this paper; does it matter if private firms, as common carriers or public utilities, enjoy eminent domain powers? The analysis here deals exclusively with efficiency questions. Delegating eminent domain powers to private profit maximizing firms operating as common carriers or regulated utilities gives them the freedom to choose their specific land routes without government interference. The question is whether this freedom leads to inefficient land use decisions. The analysis is motivated by a popular notion that property takings are inherently less efficient when undertaken by a private firm than when undertaken by a government, that is, the belief that firms have an incentive to take the "wrong" land out of residential and commercial use or to take more land than is necessary (*Rabun County v. Georgia Transmission Corp.*, 2003).

It is possible to couch this notion within the context of standard economic theory. The question is, if a firm is free to take land by eminent domain, paying the market value to the erstwhile owners, does it treat land like the other inputs (e.g., capital) in its rate base, using more than is consistent with efficient production? The nature of the transmission system for the product, whether electricity, water, or hydrocarbons, opens up addition dimensions for inefficiency that are not addressed by the venerable regulated utility model. To address these points, this paper extends the model of a regulated firm engaged in production to include long distance transportation via transmission lines or pipelines. It uses the model to evaluate whether allowing firms to choose their land routes reduces the incentive to select the most efficient route to transmit their products to distant customers. The paper also examines the extent to which including the value of land taken in the rate base prompts the firm to acquire higher value land when equally suitable lower value land is readily available.

The analysis shows that the regulated common carrier's choice of land corridor width may or may not exhibit an Averch-Johnson type bias, depending upon the relationship between capital and land in the transmission system production function. But the analysis also demonstrates that the combination of rate-of-return regulation and private eminent domain powers does not create incentives for wasteful long-distance pipelines or transmission line routes. The firm uses the same route selection rule that would be followed by an efficiency-oriented government.

2 Private Use of Eminent Domain in the U.S.

Private firms engaged in providing access to transportation infrastructure–toll roads, canals, bridges, and railroads–enjoyed eminent domain powers from the outset of the nation's founding. Similarly, many states in the 19th century gave mill owners eminent domain powers to take land for the dams and ponds needed to power their facilities. These takings required compensation. The compensation sometimes included a statutorily mandated premium over market value, but more often was set by juries or commissioners convened for that purpose. The eminent domain powers of private firms in these select industries were not controversial until the late 1800's, which is when state governments and courts began restricting such powers (Sheiber, 1973).

The Michigan Supreme Court decision *Ryerson v. Brown* (1877) represents a landmark in this regard. This decision struck down a 1873 revision of the state's Mill Act delegating eminent domain powers to any firm constructing a mill-pond to generate water power. The court based its decision on two factors, the public use doctrine and whether eminent domain remained essential in light of changing technology. With respect to the first reason, the court argued that the law was too broad since it gave eminent domain power to firms for purposes other than grist mills or similar common carriers; the acquisition of land for mill-ponds by local manufacturers not encumbered as common carriers violated the public use doctrine and was therefore unconstitutional.[3] The second reason the Michigan Supreme Court struck down the Mill Act in *Ryerson* was that by 1877 the development of steam power had made mill-ponds obsolete or, at least, not essential. Thus, acquiring privately owned land by eminent domain was no longer an act of last resort, since the viable alternative of

[3]Interestingly, the court decision in *Ryerson* clearly states that creating local employment does not meet the public use requirement, a view that contrasts with the U.S. Supreme Court decision in *Kelo v. City of New London* (2005) allowing states to define local job creation or retention as a public use for taken land. Justice Cooley states, "...the proprietor can have no valid claim to the interposition of the law to compel his neighbor to sell a business site to him, any more than could the manufacturer of shoes or the retailer of groceries. Indeed, the two last named would have far higher claims, for they would subserve actual needs, while the former would at most only incidentally benefit the locality by furnishing employment and adding to the local trade." (*Ryerson v. Brown*, 1877, 338)

steam power required no such acquisition of land. In effect, the public would suffer no loss of common carriers by denying them eminent domain powers for constructing mill-ponds.

The *Ryerson* decision provides background for understanding the rationale underlying private eminent domain in the U.S. today. Eminent domain allows common carriers to more easily obtain an essential resource—land—needed to fulfill their special roles in the economy. Thus, common carriers have long satisfied the public use doctrine for eminent domain.[4] It is not surprising that, in spite of the change of attitude in several states, some private firms still enjoy broad eminent domain powers. The Federal government grants such power to natural gas and oil products interstate pipeline operators and the eleven individual states indicated in Table 1 also delegate eminent domain powers to private firms in industries ranging from electric power to oil pipelines. As expected, the industries granted these powers share similar characteristics: not only are their facilities or production systems subject to the holdout problem, they also typically provide goods or services as common carriers or regulated utilities.[5]

Nonetheless, the notion that private sector firms are given eminent domain powers much like those exercised by governments is disquieting to some people and has stimulated a political backlash in at least one of the affected states. In Georgia, for example, the past several legislative sessions have seen proposals submitted to limit the broad eminent domain powers enjoyed by private electric transmission firms in that state. At the same time, individual county governments have challenged these

[4] The current doctrine is that common carriers satisfy the public use clause of the Fifth Amendment. This is independent of and should not be confused with the recent Supreme Court decision *Kelo v. City of New London* (2005). That decision deals with local governments' practice of using eminent domain to transfer property to other private parties. In such cases, the recipients are not regulated common carriers and therefore do not automatically fulfill the "narrow" public use clause. See, for example, Justice O'Conner's dissenting *Kelo* opinion, which specifically identifies eminent domain powers exercised by common carriers as a noncontroversial example of the narrow public use doctrine.

[5] On the other hand, Oregon, Colorado, Idaho, and Utah also delegate eminent domain powers to mining and logging firms to acquire land for roads or rail lines. These industries are not common carriers. See *Oregon Revised Statutes*, Secs. 772.410 (2003); *Colorado Revised Statutes*, Secs. 37-86-102; *Idaho Code*, Secs. 42-1102, 42-1106; *Utah Code Ann.*, Sec. 73-1-6.

powers in court.[6] Although these efforts have been unsuccessful to date, they appear to be motivated by a concern that regulated utilities have little regard for the value of the land they appropriate for their power line corridors because costly land enters their rate base and thereby increases their allowed profit.[7] A second concern is motivated by the negative externalities associated with high tension power lines (*Rabun County v. Georgia Transmission Corp.*, 2003). But the idea that route selection subjects certain neighboring property owners to otherwise avoidable negative externalities is not a problem that arises only when private firms exercise eminent domain; externalities occur even when governments influence route selection by exercising eminent domain on firms' behalf. The difference in how residents affect government system routing decisions relative to decisions undertaken by private firms matters, however, and so is addressed separately below.

Table 1 summarizes private eminent domain powers by state, as of 2005. Although eleven states delegate eminent domain powers to private firms, they place varying degrees of restrictions on them. Column (1) indicates the eleven states that clearly delegate eminent domain powers to private firms. For these eleven states, columns (2) and (3) indicate restrictions on these powers in the form of requiring public hearings and allowing local governments' zoning laws to preempt firms' land route decisions. (Note that the public hearing requirement does not take the route decision away from the firm for these states.) Georgia, Oklahoma, and Texas stand out as placing the fewest restrictions on private eminent domain powers. These three states not only give eminent domain powers to select common carriers, these powers override local government land use laws and they are not required to hold public hearings regarding

[6] Cobb, Dawson, Forsyth, Hall, Lumpkin, and Rabun Counties each tried to use their land use regulation powers to prevent eminent domain condemnations by the Georgia Transmission Corporation. Various Superior Courts and the Georgia Supreme Court reaffirmed that the eminent domain powers of the private firm preempt local zoning and land development laws (*Cobb County v. Georgia Transmission Corp.*, 2003; *Forsyth County v. Georgia Transmission Corp.*, 2006). Judging from the reactions in the local press, these counties' efforts to limit private eminent domain continue to enjoy popular support (Johnson, 2006).

[7] Justifying the ordinance in question in *Rabun County v. Georgia Transmission Corp.* (2003), the Rabun County Board of Commissioners claims that "[i]t is technically and economically feasible to provide the electric power to meet the foreseeable needs of the ... communities without constructing [the] new high voltage transmission lines." In other words, the Board views the firm's planned electric transmission line route as unnecessary rate base padding.

facility siting. All together, seven of the states that give eminent domain powers to private firms clearly override local zoning and land use laws; the issue remains unclear or unsettled in two states.

3 Land Route Selection by Regulated Firm

This section presents a model of the input and transmission route choices of the rate-of-return regulated firm. The model extends the Averch-Johnson (1962) regulated firm model to include the power transmission activities that are key to our question. The model is couched in terms of electricity generation and transmission, but the framework applies equally to other common carriers or utilities engaged in transporting irrigation water with pipelines, canals and aqueducts, or natural gas or petroleum products via pipelines, etc. The general conclusions also apply to firms engaged only in long distance transmission activities.

We use the following notation throughout:

L = length of land route of transmission line;

X = width of land corridor used for transmission lines;

T = capital used in transmission system, per unit of length;

G = capital used in the generation of electricity;

N = labor used in the generation of electricity;

w, p = labor wage rate and price of land, respectively;

$Q(N, G)$ = production function for generating electric power;

$q(Q, T, L)$ = production function for delivering generated power to retail distribution node;

$P(q)$ = inverse output demand function ($P' < 0$); and

$R(N, G, T, L) = P(q)q(Q(N, G), T, L)$ = revenue function.

Assume diminishing marginal revenue of delivered power ($dMR_q/dq < 0$) and that increasing generated power put into the transmission system increases delivered power ($\partial q/\partial Q > 0$). Also assume that the transmission system exhibits standard "line loss" behavior, in that increasing transmission route length (weakly) reduces reduces the amount of delivered power without additional capital in the form of greater transmission line width and more step-up transformers along the route ($\partial q/\partial L \leq 0$) and that using more capital in the transmission system delivers more of the generated power that is fed into the transmission system ($\partial q/\partial T > 0$). Under these assumptions the marginal revenue products of labor, generation capital, and transmission capital are positive, $R_i = MR_q(\partial q/\partial i) > 0$ for $i = \{N, G, T\}$ and the marginal revenue product of land route length is (weakly) negative, $R_L = MR_q(\partial q/\partial L) \leq 0$.

The power transmission system requires capital T can be thought of as the transmission capacity of the line and is defined per unit of line length. Therefore, the total transmission capital used by the firm is TL. In this model, the width of the land corridor required for the transmission towers (and step-up facilities) is $X(T)$, where $X' \geq 0$. If a given land corridor width accommodates the transmission tower bases (plus any buffer of vacant land required for maintenance or safety), then increasing the carrying capacity of the system by increasing the gauge of individual lines or running more parallel lines does not increase the required land corridor width and $X' = 0$. If, on the other hand, increasing the capacity of the transmission system requires a corresponding increase in land corridor width, then $X' > 0$. Of course, it is reasonable to assume that $X' = 0$ for some values of T and $X' > 0$ for others. For example, $X' = 0$ when transmission capacity can be increased using the given tower structures while $X' > 0$ when greater transmission capacity requires wider tower bases or parallel towers. In any case, the total amount of land used in the transmission route is $X(T)L$.

Let m be the length of the shortest route between the generating plant and the retail distribution node. The firm's choice of route length L can then be interpreted as its route selection. Referring to Figure 1, for example, the route running straight from the generation point a to the distribution point b has the minimum length m. The more roundabout route given by the curve f in the diagram is longer: $L_1 > m$.

There are many routes with length L_1 in the diagram. Nonetheless, we can safely ignore the firm's choice from among alternative routes of equal length without loss of generality. This treatment simplifies the model to one of depicting the firm's route selection as its choice of route length, L.

3.1 The Unregulated Firm Benchmark

First consider the unregulated firm as a point of reference. The price of acquiring capital is unity, so the total value of capital and land assets used by the firm is $G + (T + pX)L$. Given the opportunity cost of capital r, the firm's profit can be expressed as

$$\pi = R(N, G, T, L) - wN - r[G + (T + pX)L] \tag{1}$$

Maximizing (1) with respect to the active inputs N, G, T and transmission system route length L and subject to the geographic constraint $L \geq m$ yields the following conditions:

$$R_G - r = 0 \tag{2}$$

$$R_T - r(1 + pX')L = 0 \tag{3}$$

$$R_N - w = 0 \tag{4}$$

$$R_L - rpX + \beta = 0 \tag{5}$$

$$L - m \geq 0; \quad \beta(L - m) = 0; \quad \beta \geq 0 \tag{6}$$

where β is the Kuhn-Tucker multiplier for the technical constraint that route length cannot be shorter than the minimum length defined by geography.

These conditions imply the input efficiency conditions. First, (5) and $R_L \leq 0$ together require $\beta > 0$. This result coupled with the complementary slackness conditions in (6) yields the cost minimization condition that the land corridor follows the shortest route, $L = m$. For the generating capital-labor input mix, (2)-(4) yield the familiar condition that the marginal rate of technical substitution between capital and labor used in the power generation process equals the input cost ratio

$$\frac{(\partial Q/\partial G)}{(\partial Q/\partial N)} = \frac{r}{w} \tag{7}$$

while (3)-(4) yield the transmission capital-labor input mix efficiency condition that the marginal rate of technical substitution between capital used in power transmission per unit of distance and labor used in generation equals the relevant input cost ratio[8]

$$\frac{(\partial q/\partial T)}{(\partial q/\partial Q)(\partial Q/\partial N)} = \frac{r}{w}(1 + pX')L \tag{8}$$

The transmission capital input cost on the right hand side takes into account the user cost of the transmission line capacity, rL, as well as the additional land corridor width induced by an expansion of the transmission line capacity, $rpX'L$.

3.2 The Regulated Firm

Now consider the rate-of-return regulated firm. We allow for the possibility that the firm hires redundant labor (N_0), or pads its rate base with redundant capital (G_0 and T_0) and/or land used for power transmission (X_0L). The total allowed rate base for regulated firm is the sum of the generating plant base and the transmission line base plus whatever capital or land rate-base padding the firm chooses, or

$$G + G_0 + (T + T_0)L + p[X(T) + X_0]L$$

Note that the market value of land used in the transmission corridor is included in the allowed rate base.

The market rate of return to capital is r and the allowed rate of return on the rate base is s. We assume the standard condition $s > r$, which is necessary for a nontrivial equilibrium (Baumol and Klevorick, 1970). The regulated firm's problem is to maximize its profit subject to the regulatory constraint and the technological constraint that the transmission system cannot take a route shorter than the minimum distance:

$$\max_{\substack{N,G,T,L,\\ N_0,G_0,T_0,X_0}} \pi = R(N,G,T,L) - w(N + N_0) - r[G + G_0 + (T + T_0 + pX + pX_0)L]$$

$$\text{s.t.} \quad s[G + G_0 + (T + T_0 + pX + pX_0)L] \geq R(N,G,T,L) - w(N + N_0);$$

[8] Adding a separate category for labor used exclusively in power transmission is trivial and so is suppressed to conserve notation.

$$L \geq m; \quad \text{and } N_0, G_0, T_0 \geq 0$$

Denoting the Kuhn-Tucker multipliers λ and μ, the relevant Kuhn-Tucker conditions are as follows. For the "active" inputs N, G, T, and L:

$$(1-\lambda)(R_N - w) = 0 \tag{9}$$

$$(1-\lambda)R_G + (\lambda s - r) = 0 \tag{10}$$

$$(1-\lambda)R_T + (\lambda s - r)(1 + pX')L = 0 \tag{11}$$

$$(1-\lambda)R_L + (\lambda s - r)(T + T_0 + pX + pX_0) + \mu = 0 \tag{12}$$

The minimum route distance constraint, with complementary slackness, is

$$L - m \geq 0; \quad (L - m)\mu = 0; \quad \mu \geq 0 \tag{13}$$

The Kuhn-Tucker conditions for the redundant labor and capital and land rate-base padding decisions of the firm are:

$$-(1-\lambda)w \leq 0; \quad (1-\lambda)wN_0 = 0; \quad N_0 \geq 0 \tag{14}$$

$$(\lambda s - r) \leq 0; \quad (\lambda s - r)G_0 = 0; \quad G_0 \geq 0 \tag{15}$$

$$(\lambda s - r)(1 + pX')L \leq 0; \quad (\lambda s - r)(1 + pX')LT_0 = 0; \quad T_0 \geq 0 \tag{16}$$

$$(\lambda s - r)pL \leq 0; \quad (\lambda s - r)pLX_0; \quad X_0 \geq 0 \tag{17}$$

Finally, the regulatory constraint with complementary slackness is

$$s[G + G_0 + (T + T_0 + pX + pX_0)L] - R + w(N + N_0) \geq 0;$$

$$\{s[G + G_0 + (T + T_0 + pX + pX_0)L] - R + w(N + N_0)\}\lambda = 0; \quad \text{and} \quad \lambda \geq 0 \tag{18}$$

We can now turn to what rate-of-return regulation implies for the firm's choice of inputs and, more importantly for our concern, route selection. Recall that the results below do not depend upon our assumption that the firm is an integrated generation-transmission-retail operation. They easily extend to a firm that is only engaged in transporting the electrical power generated by others.

These conditions yield our first result regarding the efficiency of the input decisions by the firm.

Proposition 1 *Zero redundant input employment: The regulated firm has no incentive to hire redundant labor, pad its rate base with redundant generation or transmission capital, or pad its rate base with a greater width of the land corridor along the transmission route:* $N_0^* = G_0^* = T_0^* = X_0^* = 0$.

Proof. From the first condition in (14) and the first lemma in the appendix, we have $-(1-\lambda^*)w < 0$. The second condition in (14) then yields the labor employment result, $N_0^* = 0$. The conclusions regarding rate base padding, $G_0^* = T_0^* = X_0^* = 0$, similarly follow from (15), (16), and (17) respectively, using $\lambda^* s - r < 0$ from the second lemma. ■

This efficiency result for redundant labor and capital in the generation activity is a standard result that can also be found using the well-known Averch-Johnson production model. The above result provides a straight-forward extension to the firm's choice of capital and land inputs for its transmission system as well. Input redundancy yields no net advantage to the firm in the form of additional revenues for either power generation or transmission, even when the redundant input pads the rate base. This is because even though padding the rate base alone increases the total allowed profit, but it does not increase the firm's capacity to create more profit because it does not affect revenue. Thus, like its unregulated counterpart, the rate-of-return regulated firm has an incentive to avoid hiring redundant or unused inputs. In this dimension, at least, the firm's power generation and transmission decisions are consistent with cost minimization.

As is well-known for the power generating firm, however, this efficiency does not extend to the firm's choice of productive inputs–the Averch-Johnson effect (Baumol and Klevorick, 1970).

Proposition 2 *Averch-Johnson effect for generating capital relative to labor: The regulated firm adopts a more capital intensive input mix in power generation than is consistent with cost minimization:* $(\partial Q/\partial G)/(\partial Q/\partial N) < r/w$.

Proof. Rearrange (10) to get $(R_G - r) = -\lambda(s-r)/(1-\lambda)$ so that lemma 1 implies $R_G < r$ or $MR_q(\partial q/\partial Q)(\partial Q/\partial G) < r$. Using lemma 1, (9) implies $R_N = w$ or

$MR_q(\partial q/\partial Q)(\partial Q/\partial N) = w$. These two results together imply $(\partial Q/\partial G)/(\partial Q/\partial N) < r/w$. ■

Now consider the firm's power transmission system. Note that generated power is an input in the transmission process. We can conclude an Averch-Johnson type distortion in the input mix for the transmission operations of the firm in the usual sense, as follows.

Proposition 3 *Averch-Johnson effect for transmission capital relative to labor input: The regulated firm uses relatively greater transmission capital-labor input mix in its transmission process per transmission mile than is consistent with cost minimization:* $(\partial q/\partial T)/(\partial q/\partial Q)(\partial Q/\partial N) < r(1 + pX')L/w$

Proof. Add and subtract $\lambda r(1+pX')L$ to the left hand side of (11) and rearrange to get

$$(1 - \lambda)[R_T - r(1 + pX')L] + \lambda(s - r)(1 + pX')L = 0 \tag{19}$$

from which

$$R_T - r(1 + pX')L = -\frac{\lambda(s - r)(1 + pX')L}{1 - \lambda} < 0 \tag{20}$$

where the sign follows from $s > r$, $X' \geq 0$ and lemma 1. This implies $MR_q(\partial q/\partial T) < r(1+pX')L$, so that applying the labor employment condition $R_N = w$ from (9) yields $(\partial q/\partial T)/(\partial q/\partial Q)(\partial Q/\partial N) < r(1 + pX')L/w$, the condition to be shown. ■

What this means is that the transmission process is *relatively* over-capitalized in the sense that it uses a greater capital mix per unit distance than is consistent with cost minimization. In addition, because it uses relatively more transmission capital than is efficient, the regulated firm suffers less line loss (loss of generated power in the transmission system) per unit of distance transported than is efficient. This mix is inefficient because the additional capital the firm uses to deliver the greater proportion of generated power is more costly than the value of the power that would have been otherwise lost in the transmission process.

Since nothing has been said (yet) about the length of the transmission route, the above result need not imply that the amount of total capital to energy input in the transmission process actually used by the regulated firm is greater or less than what the unregulated monopolist would choose or that the total amount of capital used is greater or less than the efficient quantity of capital. To answer these questions, we need to know how far power is being carried, that is, the effect of regulation on the route selection.

Before turning to that result, note that for the integrated firm engaging in both power generation and transmission, there is no inefficiency in the mix of generation capital and transmission capital for given delivered output and distance.[9]

What about the firm's choice of land corridor width? Proposition 1 shows that the firm will not take more land than is minimally needed to accommodate its transmission system. In the case that we consider most likely, if the land corridor width is invariant to the carrying capacity of the transmission lines (e.g., how many lines are attached to the towers or their gauge) then the Averch-Johnson over-capitalization effect of Proposition 3 does not extend to the land corridor width. Note that there are two parts to this result: that there will be no corridor "padding" (Proposition 1) and that there will be no commensurate increase in corridor width with the transmission capacity (Proposition 2). On the other hand, if the corridor width must increase to accommodate greater transmission capacity ($X' > 0$), then the firm's land corridor is inefficiently wide–but only because of the excessive use of capital in the mix of inputs in the transmission system.

Further, recall the scale effects of rate-of-return regulation. Even without the Averch-Johnson effect, the regulated firm under increasing returns to scale technology delivers less electricity to the distribution node than required by Pareto efficiency. The Averch-Johnson effect increases the cost structure of the firm, leading to an even lower output level under regulation. Thus, the overall scale of transmission is lower than the Pareto efficient level. Even though more capital (hence corridor width) is being used per unit of delivered output, the smaller quantity of delivered output for the regulated firm implies that the regulated firm's land corridor width need not exceed the Pareto efficient width. Although the corridor might be *relatively* wide, it

[9] Use the Kuhn-Tucker conditions for inputs G and T to show the cost minimization condition that the rate of substitution between transmission and generation capital equals the user cost ratio, or $(\partial q/\partial T)/(\partial q/\partial Q)(\partial Q/\partial G) = (1 + pX')L$.

need not be *absolutely* wider than what an efficiency-motivated government run firm would use even when $X' > 0$.

Now consider the central issue for the effect of regulation on the land market, how regulation affects the firm's route selection. We have the following.

Proposition 4 *The regulated firm selects the least-cost land route for the transmission system:* $L^* = m$.

Proof. Show by contradiction. Suppose $L > m$. In this case, the second condition in (13) requires $\mu = 0$. Substituting this into the left hand side of (12) and applying the zero rate-base-padding proposition leaves $(1 - \lambda^*)R_L + (\lambda^* s - r)(T^* + pX(T^*)) < 0$, where the sign follows from the two lemmas and the transmission technology $(\partial q/\partial L \leq 0)$. Since this inequality violates the Kuhn-Tucker condition (12), we conclude that $L^* \ngtr m$ so that $L^* = m$ by (13). ■

This result might appear counter-intuitive at first. After all, it seems reasonable to anticipate an Averch-Johnson effect like that found for transmission and generation capital at work here as well. A longer route brings more land into the firm's allowed rate base. However, the lessons of rate base padding found in Proposition 1 apply here, too. Using more land by choosing a longer land route for the transmission system does not increase revenues; in fact, it can have an opposite effect by reducing the amount of delivered power for a given amount of capital per transmission distance when there is "line loss," or $\partial q/\partial L < 0$. So it turns out that this part of the regulated firm's decision resembles its rate-base padding decision. The firm has no incentive to engage in rate base padding whether in the form of redundant (unused) capital or in the form of a longer transmission route than is necessary. Put somewhat differently, empowering the regulated firm with eminent domain does not by itself lead to inefficient route selection. Introducing government oversight of the route selection process cannot lead to more efficient routes when significant negative externalities are absent.

Recall that the amount of generated power, Q, can be viewed as an input in the transmission system. Pulling together the two preceding propositions, the following result pertains as well: The regulated firm uses a more transmission capital-intensive input mix in its transmission system than is consistent with cost minimization for given amount of delivered power, or $T^*m/Q^* > T^e m/Q^e$ where superscript e indicates the efficient mix. In this sense, the regulated firm has an incentive to adopt an over-capitalized transmission system–but an efficiently routed system nonetheless.

Finally, the firm's incentive to avoid redundant or unproductive inputs has a parallel result given below. The proof is provided in the appendix.

Proposition 5 *The regulated firm will choose the land route with the lowest market value.*

This proposition establishes that, when given the choice between using land with a higher market price and land with a lower market price, the firm has an incentive to opt for the lower cost alternative–even though the total value of land used in the transmission system route enters the allowed rate base. Put in simple terms: the firm will not choose to use more valuable land in its route when lower priced land is available. The intuition resembles that underlying the firm's incentive to avoid redundant or unproductive inputs (Proposition 1). Using more costly land increases the firm's rate base, increasing the firm's capacity to earn greater profit, but it does not give the firm a corresponding ability to earn greater profit. Thus, the firm has no incentive to take higher priced land when comparable lower priced land is readily available.

The main normative conclusion bears emphasis before turning to the question of the proper government role in this process. While land corridor width may or may not exhibit an Averch-Johnson type bias for the regulated firm, we find that one of the potential arguments against granting eminent domain powers to privately run public utilities does not hold. Simply put, the combination of rate-of-return regulation and private eminent domain powers does not create incentives for capricious or wasteful routing of long-distance transmission lines. The firm follows the same Pareto rule that would be followed by an efficiency-oriented government when designating which land to take for a transmission route.

4 Discussion

The alternative to allowing private firms to exercise eminent domain effectively gives a government or government agency the route selection decision, since the government can choose to condemn the land as requested by the firm or refuse to do so until the firm chooses a "more appropriate" route. The comparison of government and private firm decisions is complicated by the fact that state and local governments are not inherently efficiency- or welfare-maximizing entities. While there are situations in which interjurisdictional competition can constrain local governments to behave efficiently with respect to taxing and spending decisions (Fischel, 2001), interjurisdictional competition does not necessarily have the same effect on eminent domain decisions. The law and economics literature has long recognized the potential for inefficient government eminent domain decisions. In fact, one economic justification of the fair market value compensation rule is that it forces local governments to weigh the gains to constituents from public use against the lost private benefits suffered by the owners of the taken land (Fischel and Shapiro, 1989). This type of constitutional constraint would not be needed if governments were naturally inclined to pursue only efficient policies. In any event, putting the routing decision for the pipeline or long distance electric transmission systems considered in this paper in the hands of a government complicates things considerably. At the least, it raises questions about how the political process balances the innate NIMBYism of local property owners in a jurisdiction against the interests of the distant consumers and industries outside the jurisdiction that will be served by the transmission system capacity. These public choice considerations suggest no convincing rationale for why government route selection should necessarily lead to efficient land use.

Finally, we briefly address another aspect sometimes raised in the popular discussion about private firms exercising eminent domain–the effects of eminent domain decisions on property bordering the transmission corridors, an issue raised in *Rabun County v. Georgia Transmission Corp.* (2003). The economic question is whether private firms neglect the externalities of their transmission systems more than would governments. The results derived in the preceding section suggest intriguing possibilities. For example, suppose that higher value land suffers greater marginal externality effects from proximity to high tension power transmission lines or gas or petroleum product pipelines than does lower value land. In this case, one consequence of Proposition 5 is that the firm minimizes negative externalities of the transmission system corridor by avoiding routes that use higher value land when comparable lower value land is available. The firm does not intend to minimize effects on surrounding property owners; instead, this result arises as a consequence of decisions motivated by its profit concerns. The underlying supposition that the negative externality of the transmission corridor affects higher priced land more than lower priced land is an (unanswered) empirical question (Jaconetty, 2001). In any case, private eminent domain decisions need not necessarily be inefficient as long as the value of negative externalities associated with the transmission system are positively correlated with the value of the land taken for the transmission system route.

Regardless of whether or not this supposition is found to hold empirically, the comparison of private firms' decisions with government decisions requires that we also consider how an elected government might or might not incorporate these externalities in its decision if it was responsible for the transmission system route selection. Given the unsettled nature of the debate over government behavior in eminent domain decisions, however, it is not immediately clear that either method of exercising eminent domain to obtain land routes for common carriers systematically deals with externalities more efficiently than the other.

5 Conclusion

This paper examined the land use implications of allowing privately owned regulated firms eminent domain powers. In light of the well-known Averch-Johnson effect for regulated common carriers and public utilities, the relevant question addressed here was whether their tendency to overuse capital extends to land use decisions as well. The analysis reveals that these firms do not have a built-in incentive to take inefficiently large amounts of land in the form of greater land corridor width. Nor do they have incentives to choose inefficiently long routes or use more valuable land when less valuable land is available that will serve the same purpose. While these results may come as a surprise to those who advocate eliminating the eminent domain powers of these firms, the results nonetheless rule out rate-of-return regulation as a source of inefficient private eminent domain decisions. To this extent, the common carrier justification underlying the nineteenth century Mill Acts remains relevant even in the twenty-first century economy.

The alternatives to private eminent domain for common carriers are not fully understood. The states that do not delegate eminent domain powers to private firms in effect put the land route decisions into the hands of a statewide agency, local governments, or both. Although beyond the intended scope of this paper, the relevant question in such cases becomes: when the land corridor route decision is made by a government body, how will the decision compare with the private firm's decision? It remains an open question whether injecting the complications of state and local politics directly into electric power transmission system or gas pipeline land route decisions necessarily improves efficiency. The answer to this question awaits the development of a clearer picture of government motives in eminent domain decisions than currently provided by the literature.

APPENDIX

Lemma 1. $0 < \lambda^* < 1$

Proof. *(i)* By (18) $\lambda^* \geq 0$. To show that the strict inequality holds by contradiction, suppose instead that $\lambda = 0$. Then the complementary slackness conditions in (18) imply that the regulatory constraint is either nonbinding or "just" binding, and the remaining Kuhn-Tucker conditions reduce to the unregulated monopoly profit maximization conditions. This implies that the firm's profit equals the unregulated firm's profit, which violates the regulatory assumption. Thus, $\lambda^* > 0$.

(ii) Proving $\lambda^* < 1$ requires that we show that $\lambda \geq 1$ cannot satisfy the Kuhn-Tucker conditions. If $\lambda = 1$ then (10) reduces to $s - r = 0$, which violates the regulatory regime assumption $s > r$. Thus, $\lambda^* \neq 1$. If $\lambda > 1$ then the first condition in (14) requires $w \leq 0$, which cannot hold. Therefore, $\lambda^* \ngtr 1$.

(i) and *(ii)* together yield the lemma. ■

Lemma 2. $\lambda^* s < r$.

Proof. The first weak inequality in the rate base padding conditions (15) requires $\lambda^* s \leq r$. To show the strict inequality holds by contradiction, note that $\lambda s = r$ substituted into the transmission capital employment condition (10) implies $(1 - \lambda^*) R_T = 0$. But the first lemma requires $(1 - \lambda^*) > 0$ so that $R_T > 0$ violates this condition. Thus, $\lambda^* s < r$. ■

Proposition 5. *The regulated firm will choose the land route with the lowest market value.*

Proof. Without loss of generality, we prove the result for otherwise identical land routes over land with market value $p + \delta$, where $\delta \geq 0$ is an index of land value along a specific alternative route. $\delta = 0$ indicates the land route that tracks the lowest value land. The firm's problem is revised to

$$\max_{\substack{N,G,T,L,\\ N_0,G_0,T_0,X_0,\delta}} \pi = R(N,G,T,L) - w(N+N_0) - r[G+G_0+(T+T_0+(p+\delta)X+(p+\delta)X_0)L]$$

$$\text{s.t.} \quad s[G + G_0 + (T + T_0 + (p+\delta)X + (p+\delta)X_0)L] \geq R(N,G,T,L) - w(N + N_0);$$

$$L \geq m; \text{ and } \delta, N_0, G_0, T_0 \geq 0$$

Denoting the Kuhn-Tucker multipliers λ and μ, the solution satisfies the Kuhn-Tucker conditions for the problem with exogenous land value. For the "active" inputs N, G, T, and L:

$$(1-\lambda)(R_N - w) = 0 \tag{21}$$

$$(1-\lambda)R_G + (\lambda s - r) = 0 \tag{22}$$

$$(1-\lambda)R_T + (\lambda s - r)(1 + (p+\delta)X')L = 0 \tag{23}$$

$$(1-\lambda)R_L + (\lambda s - r)(T + T_0 + (p+\delta)X + (p+\delta)X_0) + \mu = 0 \tag{24}$$

The minimum route distance constraint, with complementary slackness, is

$$L - m \geq 0; \quad (L-m)\mu = 0; \quad \mu \geq 0 \tag{25}$$

The Kuhn-Tucker conditions for the redundant labor and capital and land rate-base padding decisions of the firm are:

$$-(1-\lambda)w \leq 0; \quad (1-\lambda)wN_0 = 0; \quad N_0 \geq 0 \tag{26}$$

$$(\lambda s - r) \leq 0; \quad (\lambda s - r)G_0 = 0; \quad G_0 \geq 0 \tag{27}$$

$$(\lambda s - r)(1 + (p+\delta)X')L \leq 0; \quad (\lambda s - r)(1 + (p+\delta)X')LT_0 = 0; \quad T_0 \geq 0 \tag{28}$$

$$(\lambda s - r)(p+\delta)L \leq 0; \quad (\lambda s - r)(p+\delta)LX_0; \quad X_0 \geq 0 \tag{29}$$

Finally, the regulatory constraint with complementary slackness is

$$s[G + G_0 + (T + T_0 + (p+\delta)X + (p+\delta)X_0)L] - R + w(N + N_0) \geq 0;$$

$$\{s[G + G_0 + (T + T_0 + (p+\delta)X + (p+\delta)X_0)L] - R + w(N + N_0)\}\lambda = 0; \quad \lambda \geq 0 \tag{30}$$

In addition, the relevant conditions for which route to select, the high priced or low priced route, is the condition for the choice of δ subject to the non-negativity constraint, or

$$(\lambda s - r)(X + X_0)L \leq 0; \quad (\lambda s - r)(X + X_0)L\delta; \quad \delta \geq 0 \tag{31}$$

Proceeding as in the previous model, prove that Lemma 2 holds for this model. Using this lemma, conclude that $(\lambda s - r)(X + X_0)L < 0$ so that $\delta = 0$ by the non-negativity condition in (31), which proves the proposition. ∎

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Table 1. Summary of Regulated Common Carrier and Public Utilities Eminent Domain Powers by State.

State	(1) Allow Private Firms Eminent Domain	(2) Require Hearing by Regulatory Body	(3) Local Zoning to be Considered
AL	Yes	Yes	Unsettled
AR	Yes	Yes	No
AZ	No		
CO	Yes	Yes	Yes
CT	No		
DE	No		
FL	No		
GA	Yes	No	No
ID	Yes	Yes	Unsettled
IL	Yes	Yes	No
IN	Yes	Yes	No
KS	Yes	Yes	No
KY	No		
LA	No		
MD	No		
ME	No		
MI	No		
MN	No		
MO	No		
MS	No		
MT	No		
NC	No		
ND	No		
NH	No		
NY	No		
OK	Yes	No	No
OR	Yes	Yes	Yes
SC	No		
TN	No		
TX	Yes	No	No
UT	No		
VA	No		
WA	No		
WY	No		
Total Yes	11		

Notes: Some states are not listed in this table either because relevant statutes, constitutions, and state court decisions are conflicting or ambiguous.

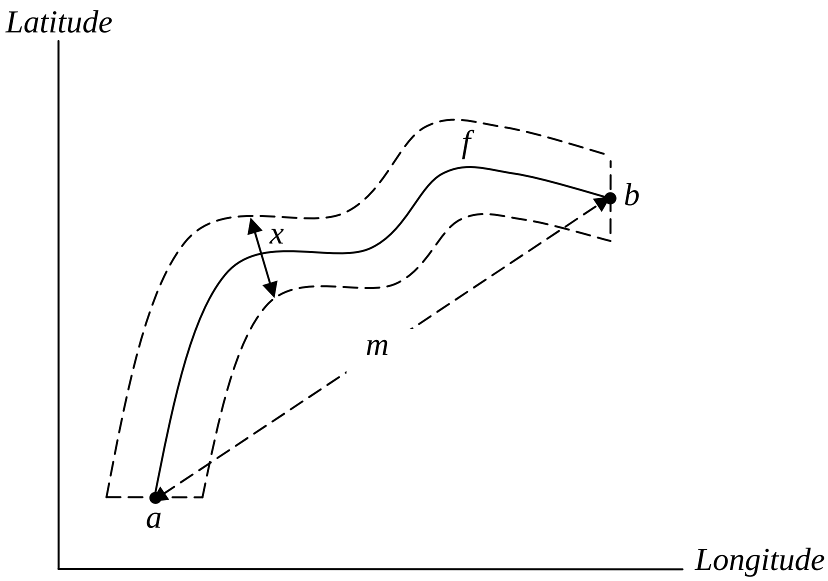

Figure 1. Land route *f* with corridor width *x* from generation site *a* to distribution node *b*. Length of route L = $\oint_a^b f$.