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Vertical Integration, Competition and Efficiency In the Rail Industry

INSTITUT D'ECONOMIE INDUSTRIELLE

IDEI Report #5 on Passenger Rail Transport

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Vertical Integration, Competition and Efficiency in the Rail Industry

Vertical Integration, Competition and Efficiency in the Rail Industry

prepared by

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Introductory Remarks

In the European Union and elsewhere, there are diverging opinions concerning the costs and benefits of vertical integration in the rail industry. Traditionally, national rail markets in Europe have been marked by large, vertically integrated, national operators. Some economists and some policy-makers believe that vertical separation would boost competition in the rail industry, and would make the rail sector more attractive compared to inter-modal competitors like car and airplane. Others believe that separation of infrastructure from operations reduces the efficiency of the rail sector and that the potential anti-competitive effects of integration can be mitigated by appropriate regulation.

This report contains two parts that look at some of the relevant arguments concerning competition and efficiency effects of vertical integration. The report is meant to be a progress report, not a final output. Our work on the topic vertical integration continues.

The first part presents a simple industrial organization model that compares two situations: In the first situation, a monopolistic infrastructure provider is integrated with a downstream operator who competes with other operators. In the second situation, the infrastructure monopoly is separated from downstream operations. Our simple model shows that the degree to which separation can enhance downstream competition depends on the financial capability of a regulator (or a procurement agency). More precisely, while separation increases the quantities of traffic downstream, it is also associated with an increase in the subsidies that must be paid for the provision of infrastructure services.

The second part presents a survey of the work of transaction cost economics on vertical integration. The survey shows that over some period of time, the literature has put much emphasis on incentives to invest in integrated and separated structures. It also identifies some more recent work that looks on the problems of day-to-day coordination and adjustment processes, and on related empirical work. Besides making an effort to bring together relevant literature, this part is also meant to define a framework for the elaboration of case studies from *Deutsche Bahn* that could be useful to teach us more about the functioning of a vertically integrated railroad firm.

Part 1

Vertical Integration, Access Regulation and the Costs of Public Funds (With Implications for Railroad Reforms)[1]

[1]This part has been written with Aldo Gonzales. We thank Gary Biglaiser, Sergei Guriev, Marc Ivaldi, Markus Ksoll, Russell Pittman and Patrick Rey for helpful discussions. All errors are ours.

1. Introduction

Throughout the least two decades, network industries have gone through substantial reforms. Many countries have deregulated their electricity, gas, telecom, water and air transportation markets. There are important efforts to integrate markets across borders in order to increase consumer welfare.

Reforms in the railroad sector have until recently been slow, but there is now a similar push towards more integrated markets, in particular in the EU. The European Commission, in its White Paper (EC, 2001), has declared the development of the European railway system one of its priorities. Open access to national railway markets (EC, Directive 91/440) is a cornerstone of the reforms, and more concrete steps, in particular, in the freight market have been undertaken.[2]

Most of the large railroad firms used to be (or - still are) monopolies on their national market. They are now faced with the prospect of EU-wide deregulation and, ultimately, the prospect of privatisation. Traditionally, national rail network firms are integrated; they comprise both infrastructure and operations. One of the crucial questions in the reform debate in the EU, but also in transition economies such as Russia, is whether infrastructure should be separated from operations prior to privatization or whether integration should be maintained even after privatization.

There is a strong belief that the separation of infrastructure from operations is a necessary condition to make the sector more competitive. The following quote from a speech by Mario Monti (2002) is representative for this view:

> "The problem with vertically integrated incumbents in an emerging competitive market is well known and is not new. Such a company is present in all the most important stages of the sector's activities including, crucially, applying the conditions of access to the network. This can lead to discrimination against third parties. A company which is engaged not only in marketing capacity on its network but also providing its own services over that network may find it difficult to resist the temptation to favour its own services over that of a competitor, particularly where there are financial transfers within the structure which encourage it to behave in that way."

In this paper, we set up a simple model of competition in the rail market and look at the desirability of separation *vs* integration, taking into account the fact that railroads are a business with very high fixed costs that need to be covered either by transfers from the government or by access charges.[3] We stress an important element that has been absent from the discussion: the costs of public funds. The main finding is that separation is always welfare enhancing if fixed costs can be financed by costless transfers, but that this is no longer the case if transfers are socially very expensive. Put differently, the benefits of separation in terms of more competition may conflict with another goal of reforms, namely, the stabilization of budgets.

[2] According to the EU Directive 2001/14/EC there should be "open access" to national rail infrastructures in the freight market beginning in 2007 and in the passenger market beginning in 2010.

[3] The report by NERA (2004) provides further information.

In our model, there is an integrated firm that provides infrastructure for its own downstream operations. It also sells infrastructure access to a downstream competitor. Throughout the paper we assume that downstream prices are unregulated, which is in line with the way transportation markets function in most countries. However, access prices may or may not be regulated.

In Section 2, we assume that access prices are unregulated. We show that the incumbent's incentives to foreclose the market are higher, the larger the degree of substitution between the incumbent's and the entrant's downstream activities, and the less efficient the entrant. They are also more pronounced if only linear access prices can be charged, rather than two-part tariffs. We do not claim much originality for these results, rather the Section's main goal is to provide a simple framework for the analysis of the effects of access price regulation, carried out in Section 3.

In Section 3, we show that the desirability of vertical integration *vs* separation depends on the cost of public funds. When transfers from the goverment to the infrastructure provider are socially inexpensive and access prices can be below or at marginal cost, then separation always dominates. Otherwise, integration may be better from the point of view of society. The intuition for this result is that a vertically integrated firm considers the true costs of infrastructure production, rather than just a regulated access price. While non-integrated competitors reduce their quantities when access prices are above marginal costs, this is not the case for an integrated firm. Rather, the integrated firm expands its production, albeit not to the point that it would fully compensate the reduction of quantity of the competitor. Nonetheless, the negative effect of higher access prices under integration is weaker than under separation.

We believe that it is important to consider explicitely the tradeoff between more competition and higher transfers that we point to. Although it is certainly right that separation of infrastructure from operations makes the sector more competitive, our model shows that this may only be feasible, if the regulator is wealthy enough to cover fixed costs by sources that come from outside of the industry. However, it may be quite costly to raise these sources. International estimates of the costs of raising one Euro of public funds are between 30 cents for developped and more than 90 cents for less developped countries (see Auriol and Picard, 2004). The higher the costs of public funds, the more fixed costs must be covered through access charges, and the less likely it is that there will be welfare gains when separation takes place. Naturally, the tighter the budget constraint of a country, the more one should expect that the costs of public funds matter in any regulatory decision taken.

Section 3 has an additional result: If a regulator can use two-part access charges, market structure does not matter any more, and in the absence of information asymmetries, the first best can be implemented through any market structure. Compared to the case of linear access prices, the access charge and therefore downstream prices are lower.

Our model is in line with the literature on access pricing and market structure choice. Laffont and Tirole (1999) propose a Ramsey-Boiteux access price regulation as the second-best solution when direct and costless transfers from the regulator are not possible. This implies that infrastructure fixed costs are financed through access charges. When access charges exceed the marginal cost, distortions in the downstream segment emerge. These can be minimized by access charges that differentiate between operators, such that services that are more price-sensitive or more elastic have a lower mark-up than services that are more demand-inelastic. In Laffont and Tirole (1999), firms have no downstream market power, but the main results hold if there is market power. Then, the access charge is used to trade off financing the fixed cost and reducing downstream distortion. This is a very similar trade-off to the one present in our model, and in our model, similar conclusions hold concerning the usefulness of access charge differentiation.[4]

Vickers (1995) focuses on the compromise between efficient downstream pricing and excessive entry, using access charge and market structure (vertical integration or separation) as instruments to regulate the level of downstream entry in the market. In his model entry is free as long as firms can pay the fixed cost of entry. Therefore the number of downstream operators is endogenously determined by the magnitude of the fixed cost, the regulated access charge and the chosen market structure. As in our model, there is no regulation in the downstream segment. Higher access charges makes entry more difficult, leading to higher consumer prices but preventing duplication of fixed costs. In the framework of symmetric information, Vickers finds that under vertical integration, access charges are higher than under separation. This discourages entry without distorting too much the operating market, for the same reason as in our model: the integrated company considers the real cost of access when setting its downstream price.[5]

While in Vickers (1995) model the concern is excessive entry, in the railroad sector, it is rather the lack of competition. Hence, in our model there is a different effect of vertical integration: it leads to less competition than separation, but it also involves less subsidisation. We look explicitely at how the budgetary constraints of a government affects - through the choice of integration vs separation - competition in the market. To that extent our paper complements Auriol and Picard (2004) who look at the impact of budgetary constraints on privatisation policies in development economies.

In the last section, we briely discuss the implications of our model for EU reforms and the reforms in the Russian railroads. We also discuss information asymmetries between regulator and firms that are not discussed in the model, but certainly of high importance.

2. Foreclosure in the absence of regulation

We first investigate a vertically integrated firm's incentives to foreclose the entry of a downstream competitor. We identify the circumstances under which foreclosure is more or less likely and examine the effects of different instruments of the vertically integrated firm, that is, linear vs non-linear access charges.

2.1. Linear access charge. In our model the vertically integrated firm, the *incumbent*, faces a potential *entrant* in the downstream market. Downstream firms are engaged in Cournot competition, that is, they simultaneously decide on how

[4]We are not the first who find that access price differentiation may be useful in covering railroad fixed costs - see Pittmann (2004).

[5]Armstrong, Cowan and Vickers (1997) investigate cases where demand specifications lead to optimal access charges larger than the marginal cost of access ($a \geq c$). Then, vertical integration tends to dominate separation. The opposite result holds if the optimal access charge is below the marginal cost of access: separation then dominates integration.

much quantity to put on the market, in the case of railroads, frequency and capacity of trains.

Notice that this setting is in line with the plans of the European Commission to provide non-discriminatory access in the freight market. There are also plans to transform European long-haul passenger traffic in an open market like the German one. The setting is however less applicable to subsidized local traffic, where there is only competition for the market (through franchise contracts) but not in the market. Moreover, prices are regulated by the procurement agency.

Downstream operators need access to track and other infrastructure. We assume that operators need one unit of infrastructure capacity for each unit of final good. The integrated incumbent firm has two sources of revenues: from selling infrastructure access and from downstream operations. From the perspective of the incumbent, the entrant is a buyer upstream, but a competitor downstream. The incumbent chooses access charges taking in account their effect on both revenue sources, which makes the analysis non-trivial.

We model this decision as a two-stage process where, first, the incumbent decides on the access price to infrastructure, a, and then, knowing a, the two firms compete in quantities as described above. We define $B_i(q_i, q_j)$ as the gross benefit of the each downstream operator. The integrated firm maximizes:

$$\max_{q_1} \Pi_1 = B_1(q_1, q_2) - C(q_1, q_2) + aq_2. \tag{2.1}$$

Here $C(q_1, q_2)$ is the cost function of providing infrastructure access given the traffic volume of the two downstream firms. The entrant maximizes:

$$\max_{q_2} \Pi_2 = B_2(q_2, q_1) - aq_2. \tag{2.2}$$

Notice the difference in the profit functions of the incumbent and the entrant. Across firms the transaction occurs through the access charge (aq_2), but inside the integrated firm, transactions have a different nature. As shown before, the integrated firm takes into account the effect on the global profit of the integrated company in all its decisions, for instance, when choosing the access charge. This is in line with previous literature, for instance, Vickers (1995).

Proceeding by backward induction, we solve first the competition equilibrium of the last stage (the downstream competition). The profit maximizing decisions yield:

$$\begin{aligned} \frac{\partial B_1}{\partial q_1} - \frac{\partial C}{\partial q_1} &= 0, \text{ for the incumbent,} \\ \frac{\partial B_2}{\partial q_2} - a &= 0, \text{for the entrant.} \end{aligned} \tag{2.3}$$

From this, we obtain the quantities offered by each operator as a function of the access charge: $\{q_1^*(a), q_2^*(a)\}$.

In the first stage, the incumbent sets a in order to maximize :

$$\max_{a} \Pi_1 = B_1(q_1^*(a), q_2^*(a)) - C(q_1^*(a), q_2^*(a)) + aq_2^*(a), \tag{2.4}$$

which results in the following first-order condition:

$$\frac{d\Pi_1}{da} = \frac{\partial \Pi_1}{\partial a} + (\frac{\partial B_1}{\partial q_1} - \frac{\partial C}{\partial q_1})\frac{\partial q_1}{\partial a} + (\frac{\partial B_1}{\partial q_2} - \frac{\partial C}{\partial q_2} + a)\frac{\partial q_2}{\partial a}.$$

From the maximization problem of the last stage, we know that $\frac{\partial B_1}{\partial q_1} - \frac{\partial C}{\partial q_1} = 0$. Hence, the second term of the right hand side of the above equation disappears. Rearranging, we obtain:

$$\frac{d\Pi_1}{da} = \overbrace{q_2 + (a - \frac{\partial C}{\partial q_2})\frac{\partial q_2}{\partial a}}^{\text{Upstream effect}} + \overbrace{\frac{\partial B_1}{\partial q_2}\frac{\partial q_2}{\partial a}}^{\text{Downstream effect}} \tag{2.5}$$

Equation (5) identifies the two effects that drive the incumbent's choice of the access price. What we call the "upstream" effect is similar to any other monopoly selling a good to a buyer, in our case, the entrant. The second term, the "downstream effect", captures the effect of entry on the downstream profits of the incumbent. Whether or not the incumbent asks a higher price than in a standard unrelated market monopoly setting depends on the sign of the downstream effect. When the goods are substitutes, $\frac{\partial B_1}{\partial q_2} < 0$; also, as $\frac{\partial q_2}{\partial a} > 0$, the downstream effect is positive. Increasing a then increases the profits of the incumbent, and the price the incumbent asks is higher than it would be in a situation of unrelated markets. The incumbent here uses a higher access price to make the entrant less competitive and to protect his downstream profits. This effect is larger, the more substitutable the goods are, that is, the larger the "business-stealing" effect of the entrant.

Consider for instance that the entrant's services have no effect on competition, that is, $\frac{\partial B_1}{\partial q_2} = 0$. Then, the optimal access charge (a_M) is set in away that the competitor can enter the market. When the stealing effect increases, the optimal choice of a increases as well. As the access charge departs form a_M, the profits extracted from the entrant decreases, but it is compensated by avoiding losses in the downstream market. When the business stealing effect is very large, it may be in the interest of the incumbent to set a as big as possible or equivalently to deny the access.[6]

If services are complements, however, the term is negative and in consequence the incumbent would want to encourage the entrant to increase his supply. Thus, the incumbent would charge an access price below the one that the upstream firm in case of separation would charge.

Whether train services are substitutes or complements to each other is not always a simple question. In particular, it depends on whether an entrant feeds new traffic in the system, either directly, into existing connections of the incumbent, or by making rail in general a more competitive option in intermodal competition. In case the incumbent operates a network of origin-destination nodes, it has to take in account the net impact of the new service provided by the entrant in the whole network.[7]

Besides the level of differentiation among products, there is a second force that is important for the incumbent's access price setting behavior: the efficiency of a potential entrant. When the entrant has high marginal operating costs or high cost

[6]This occurs when the value of the total profit with respect to the access charge is always positive,that is, when $\frac{\partial^2 \Pi}{\partial a^2} \geq 0$.

[7]In equation 2 the term $\frac{\partial B_1}{\partial q_2}$ has to be replaced by $\sum^{i=1,n} \frac{\partial B_i}{\partial q_2}$ .where i is the index of services or routes offered by the incumbent.

of entry, the profits that the incumbent can extract trough access charges are low and it is less attractive for the incumbent to provide the entrant with access. The upstream effects becomes negligeable, the downstream effects dominates and the incumbent will have more incentives to foreclose the access.

A final observation. Assume that the incumbent does not want to block entry (the access price is not infinite). Then, there exists an a that solves $\frac{d\Pi_1}{da} = 0$, and the value of the access charge is:

$$a^* = \frac{\frac{\partial C}{\partial q_2} - \frac{\partial B_1}{\partial q_2}}{1 + \frac{1}{\varepsilon_a}} \tag{2.6}$$

Here $\varepsilon_a = \frac{\partial q_2}{\partial a}\frac{a}{q_2} \leq 0$ represents the elasticity of the entrant's demand for infrastructure input with respect to the access price. The value of a^* depends positively on the marginal cost of access and on the level of substitution among services, and negatively on the elasticity of demand for access to the infrastructure.

This expression for a^* has some similarity with the "ECPR" formula originally developed by Willig (1979) and popularized by Baumol (1983), which can be written as $a_{ECPR} = \frac{\partial C}{\partial q_2} - \frac{\partial B_1}{\partial q_2}$. The Efficient Component Price Rule, often used by courts and regulators in order to determine the "fair" access charge to a bottleneck asset states that the access charge to an essential facility shall be equal to the cost of providing access plus the incumbent's forgone profit in the downstream market caused by the entrant. The ECPR access charge takes in account the entire opportunity cost that entry causes to the incumbent, but does not allow for monopoly pricing. The difference between a^* and a_{ECPR} is the denominator of equation (6), which corresponds to the extraction of monopoly profits applied by the incumbent. Notice that the unregulated access charge, a^*, is always lower than a_{ECPR}, as $\varepsilon_a \leq 0$.

2.2. Two-part tariffs. We here allow for schemes of the type (a, T). If the entrant accepts, both firms compete using quantities as instrument. The profit function for the incumbent is:

$$\Pi_1 = B_1(q_1, q_2) - C(q_1, q_2) + T + aq_2$$

and for the entrant:

$$\Pi_2 = B_2(q_2, q_1) - T - aq_2$$

Since T is given at the second stage, the optimal choice of q_i of both firms yields the same result as in the case of linear charges. Thus, knowing $q_1^*(a)$ and $q_2^*(a)$,the incumbent makes his optimal choice of a and T at stage one. If the integrated firm wants the entrant to be in the market it fixes T such that:

$$\begin{aligned} \Pi_2 &= B_2(q_2^*(a), q_1^*(a)) - T - aq_2^*(a) = 0 \Rightarrow \\ T^* &= B_2(q_2^*(a), q_1^*(a)) - aq_2^*(a) \end{aligned}$$

which implies that the incumbent, if it has perfect information, can extract the entire surplus form the entrant.

Thus, the incumbent chooses a in order to maximize:

$$\Pi_1(a) = B_1(q_1^*(a), q_2^*(a)) - C(q_1^*(a), q_2^*(a)) + aq_2^*(a) + B_2(q_2^*(a), q_1^*(a)) - aq_2^*(a)$$

We can re-write this as:

$$\Pi_1(a) = \Pi_1 + \Pi_2$$

The first order condition of the maximization are obtained from :

$$\begin{aligned}\frac{d\Pi_1}{da} &= \frac{\partial \Pi_1}{\partial a} + \frac{\partial \Pi_1}{\partial q_2}\frac{\partial q_2}{\partial a} + \frac{\partial \Pi_2}{\partial a} - \frac{\partial \Pi_2}{\partial q_1}\frac{\partial q_1}{\partial a} \Rightarrow \\ &= q_2 + (a - \frac{\partial C}{\partial q_2})\frac{\partial q_2}{\partial a} + \frac{\partial B_1}{\partial q_2}\frac{\partial q_2}{\partial a} \underbrace{-q_2 + \frac{\partial B_2}{\partial q_1}\frac{\partial q_1}{\partial a}}\end{aligned}$$

Compared to the case of linear access charges there is now a new term in the derivative, which corresponds to the effect of the access charge in the profits of the competitor. Using the fixed charge T, the incumbent can extract the entrant's profits, and there is less of an incentive to make the entrant less competitive by using a higher a. If under linear tariff the incumbent allows entry, the same will be true under two-part tariffs. The same effects that make foreclosure more likely under linear tariffs will also be present under two-part tariffs, but their intensity is diminished. The business stealing effect is less harmful to the incumbent as part of the profits that the entrant takes away from the incumbent can be recouped trough the fixed charge T. In terms on the effect to downstream consumers, since entry is more likely to take place with two part tariffs, they will benefit more and also they will enjoy lower prices.[8]

3. Access charge regulation

We first assume that the regulator uses only two instruments: A linear access charge a paid by the entrant to the incumbent and a transfer T_1 paid by the regulator to the incumbent. As we will see, the need for this direct transfer T_1 is owing to the presence of imperfect competition downstream and to covering fixed costs of infrastructure. We then look at a regulator who can use two-part access tariffs and can thus extract the surplus from the downstream operators. We also show that whether or not a regulator wants vertical integration depends on the shadow costs of public funds, that is, how costly is for the government to subsidize the industry.

3.1. Linear access charge and transfers to infrastructure provider. Using the same model as above we introduce some simplifications. The cost function of the incumbent for providing infrastructure is equal to $C_U = K + c(q_1 + q_2)$,with K the fixed and c the unit-variable part of the costs. As before, q_1 and q_2 are the quantities supplied downstream by each operator. The cost of operation in the final market - besides the cost of access - is zero for both downstream firms. The downstream demand for transport services is represented by the linear function: $Q(P) = \theta - \nu P$, where P is the final consumer price. The total quantity supplied downstream is $Q = q_1 + q_2$ which implies that the products are homogeneous.

[8] For any optimal a^* to be applied in the case of linear access charge, the solution (in terms of profits to the incumbent) can be replicated with an access charge a' and a fixed charge T' such that $a' \leq a^*$.

The regulator fixes access price a and makes a transfer T to the incumbent with the purpose of maximizing social welfare under the constraint that the upstream monopolist has to break even. Transfers are costly: raising public funds is associated with deadweight losses that are represented by $\lambda \geq 0$. The consumer surplus of downstream services is denoted by $S(Q)$,with $S'(Q) \geq 0$ and $S''(Q) \leq 0$. As before, there is no downstream price or quantity regulation.

The regulator maximizes:

$$Max : W = S(q_1 + q_2) - c(q_1 + q_2) - K - \lambda T \tag{3.1}$$

subject to the following constraints:

(1) Break-even condition for the bottleneck:

$$\Pi_U = T + (a - c)(q_1 + q_2) - K \geq 0.$$

(2) Only positive transfers :

$$T \geq 0$$

(3) Downstream Cournot competition:

$$q_1 = q_1(a), \qquad q_2 = q_2(a) \Longrightarrow q_1 + q_2 = Q(a) \tag{3.2}$$

Notice first that in equilibrium, the first constraint will be satisfied with equality as increasing transfers or access charges above break-even level is costlyto society. The second constraint rules out that the industry can be taxed to finance the public budget. The third condition states that downstream production is affected by the choice of access price and hence also on the structure of the industry, i.e. whether there is vertical integration or separation.

Replacing the first constraint into the regulator's program, we obtain:

$$W = S(Q) - (1 + \lambda) cQ + \lambda aQ - (1 + \lambda)K, \text{ with } Q \equiv Q(a) \tag{3.3}$$

Optimizing with respect to a yields:

$$S'(Q) = P = (1 + \lambda) c + \frac{\lambda}{-Q'(a)} \frac{d(aQ)}{da} \tag{3.4}$$

The interpretation of equation (10) is as follows: When transfers from the government are not costly ($\lambda = 0$), the optimal price is equal to the marginal cost of services c. In this case, downstream quantities are first best. Recall that firms have market power in the downstream segment. In order to induce the firms to charge $P = c$ rather than $P(a) \geq a$, the regulator subsidizes the access charges downstream operators pay ($a \leq c$). The losses of the upstream division are covered by T that is, a lump sum transfer. Here, T covers both the fixed cost and the difference $(c - a)Q$.

However, for values of $\lambda > 0$, the equilibrium price increases because the regulator dislikes paying subsidies and uses access charges also to fund the fixed costs of infrastructure. In general, the optimal access charge is a trade-off between paying transfers with public funds and decreasing downstream consumption (by increasing the access charge).

To see this graphically, we define iso-welfare curves in the (Q, a) space. Looking at the objective function, equation (7), it is clear that at a given level of Q, welfare is increasing in a because it demands lower amount of public funds, and at a given level of a,welfare is increasing in Q.[9]

In order to find the optimum pair of quantity supplied and access charge (Q^*, a^*) we need to introduce the downstream competition condition. We have two possible market structures:

i) Vertical Separation. Here, both firms face the same marginal cost of input equal to a. In equilibrium, both firms supply the same quantity:

$$q_1(a) = q_2(a) = \frac{1}{3}(A - ba) \Longrightarrow Q^S(a) = \frac{2}{3}(A - ba).$$

ii) Vertical Integration.

Here, there is no longer symmetry in the downstream market. The integrated firm faces a marginal cost of c, while the competitor has a marginal cost equal to the regulated access charge a. Quantities are:

$$\begin{aligned} q_1(a) &= \frac{1}{3}(A - b(2c - a)), \text{ for the integrated firm} \\ q_2(a) &= \frac{1}{3}(A - b(2a - c)) \Longrightarrow Q^I(a) = \frac{1}{3}(2A - b(c + a)), \text{for the entrant.} \end{aligned}$$

The two market structures are represented in the (Q, a) space by a straight line. Is easy to check that the slope of the $Q^S(a)$ respect to a is steeper than the slope of $Q^I(a)$. Also we have:

$$\begin{aligned} Q^S(a = 0) &\geq Q^I(a = 0) \text{ and} \\ Q^S(a = c) &= Q^I(a = c). \end{aligned}$$

Putting together the iso-welfare curves and the quantities into one graph:

We observe that first, when the optimal a^* is larger than c, welfare is higher under vertical integration than under separation. In the graph, this represented by the tangency point of the iso-welfare curves W_i with Q^S and Q^I.

Second, whether a^* is larger or smaller than c is endogenous to the parameters of the model. In particular, it depends on λ: For higher shadow values of the public funds, the iso-welfare curves are steeper and the optimal points are located more to the south-east direction of the graph. Put differently, for higher λ, the regulator must increase a to finance the infrastructure. This, reduces Q as downstream firms contract their supply.

Solving for both market structures yields:

$$a^I = \frac{A[2\lambda - 1/3] + 2/3cb}{b(2\lambda + 1/3)}; Q^I = (A - bc)\frac{(1 + 2\lambda)}{(1 + 6\lambda)}.$$

$$a^S = \frac{A[\lambda - 1/3] + (1 + \lambda)\theta b}{2b(\lambda + 1/3)};\ Q^S = (A - b\theta)\frac{(1 + \lambda)}{(1 + 3\lambda)}.$$

Both a^I and a^S are increasing in λ and the total quantity Q is decreasing in λ for both market structures. Notice also that $Q^S \geq Q^I$ for all $\lambda \geq 0$.

Third, and most importantly, the above arguments imply that:

[9] We have to add the condition that the iso-welfare curves have negative slope: $\frac{dQ}{da} \leq 0$,and are convex: $\frac{d^2Q}{da^2} \geq 0$.

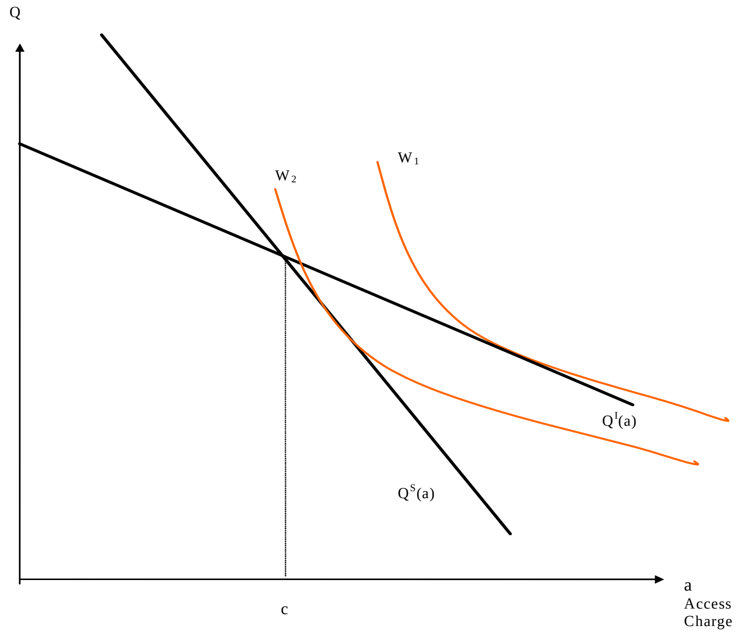

FIGURE 1. Examples for equilibria under separation and integration

PROPOSITION 1. *There is some λ^* such that for $\lambda > \lambda^*$ welfare is higher under vertical integration and for $\lambda < \lambda^*$ welfare is higher under separation.*

As an example, suppose that $\lambda = \frac{1}{3}$, then $a^S = c$ and $a^I \geq c$ which implies that welfare under integration is higher than under separation since the tangency point is below the intersection of the lines Q^I and Q^S. Now, if $\lambda = \frac{1}{6}$, then $a^I = c$ and $a^S \geq c$. Then, welfare with separation is higher than integration, which also holds for any $\lambda \leq \frac{1}{6}$. Therefore, by monotonicity, there exists a λ^* where $\frac{1}{6} \leq \lambda^* \leq \frac{1}{3}$, such that $W^I(\lambda^*) = W^S(\lambda^*)$. Figure 2 plots this situation in which the same iso-welfare curve is tangent to the supply curves of integration and separation.

From our simple model we can extract the following conclusion: The choice of market structure depends on the cost of the transfers that the regulator pays to the upstream monopolist. For high values of λ, funding of the infrastructure will be mainly by access charge. These access charges distort the downstream market because the operating companies take in account their cost when deciding their quantities. This distortion is mitigated through vertical integration since the integrated firm tends to produce more when rival cost increases. However, this increased production does not offset the decreased production of the non-integrated firm, and the net effect in the total quantity supplied is lower when we have vertical separation $(-\frac{\partial Q^S}{\partial a} \geq -\frac{\partial Q^I}{\partial a} \geq 0)$. Hence, if λ is low enough, vertical separation is desirable: When access can be subsidized $(a \leq c)$, there is more intensive downstream competition and there are higher quantities. In turn, for λ high enough, vertical integration is desirable. Put differently: the larger the fraction of infrastructure fixed costs that must be paid by users, the more likely vertical integration is desirable from the point of view of society.

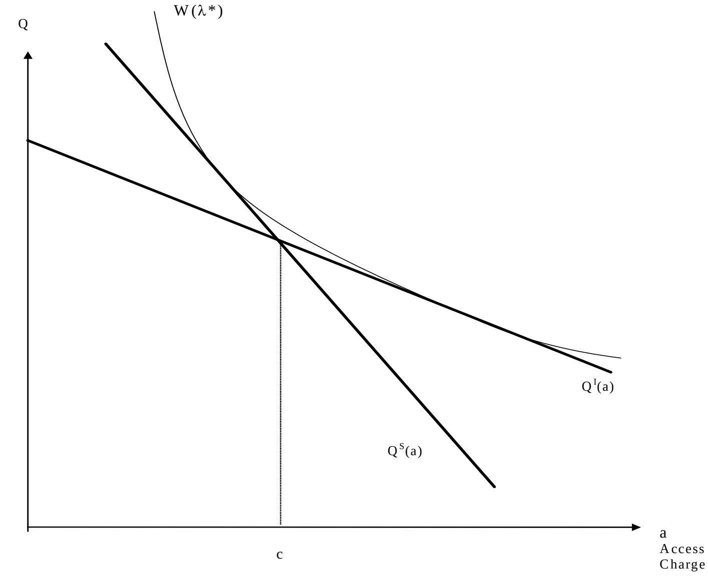

FIGURE 2. Equilibria when $\lambda = \lambda^*$

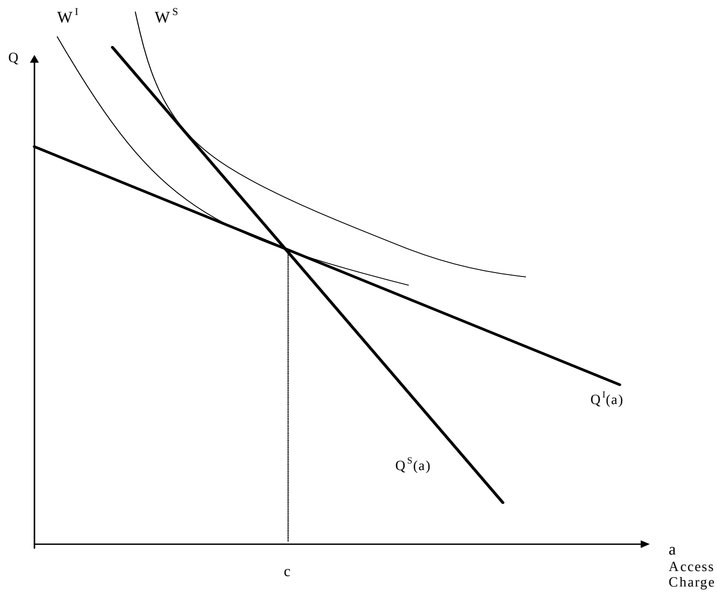

FIGURE 3. Separation equilibrium dominates integration

3.2. Two-part access tariffs. We now allow for the regulator to also impose transfers T_1 and T_2 from each downstream operator in order to make the upstream division break-even. The potential benefit of this additional instrument is the saving in public funds that are going to be replaced by the profits of the two operators.

The regulator maximizes:

$$\begin{aligned} Max &: W = S(q_1 + q_2) - c(q_1 + q_2) - K - \lambda T \\ & \quad s.t. \\ \Pi_U &= T + T_1 + T_2 + (a - \theta)(q_1 + q_2) - K \geq 0 \\ \Pi_i &= (P - a) q_i - T_i \geq 0 \text{ for } i = 1, 2 \end{aligned}$$

As it is never optimal to leave rents to downstream firms, (either because then, the transfers from the government could be reduced or because one could further decrease the access price), the constraints can be pooled into what we call the "industry feasibility constraint":

$$\Pi = T + (P - c)(q_1 + q_2) - K = 0$$

Replacing the industry feasibility constraint the regulator's program becomes:

$$\begin{aligned} Max &: W = S(Q) - (1 + \lambda) cQ + \lambda P(Q) Q - (1 + \lambda) K \\ s.t.\ Q &= Q(a) \end{aligned}$$

This programme differs from the one in which downstream firms cannot be charged lump-sum transfers as the rents that can be extracted from the industry change from λaQ to λPQ. Provided that $P(a) \geq a$, we can infer that the welfare is higher when the regulator can employ two part tariffs for the access charge.

Solving the maximization program, and replacing $S'(Q)$ by $P(Q)$ yields

$$P = c - P'(Q) Q \frac{\lambda}{1 + \lambda}$$

As before, when $\lambda = 0$, we can set the price equal to marginal cost of the service and pay all the fixed cost K with a costless transfer from the government. The most important implication is that the optimal solution is independent from a, that is, the optimum can be implemented through both market structures, vertical integration or separation. Access charges and lump sum transfers will vary according to each case, but the total quantity offered downstream and the transfer to be paid to the incumbent will be the same. Hence, if it is possible to use two-part tariffs, the competitive distortions that are present under linear access charges can be eliminated.

4. Implications and concluding discussion

Our simple model generate two insights: First, while in the absence of perfect regulation separation of infrastructure from operations does increase competition and hence induces more traffic, it is also more expensive in terms of subsidies. Second, if the regulator can use two-part access charges, market structure does not matter, and in the absence of information asymmetries, the first best can be implemented through any market structure. Compared to the case of linear access prices, the access charge and therefore downstream prices are lower.

The model shows that there does not seem to be a "one-size-fits-all solution" to the problem of restructuring of network industries. Indeed, a casual look at the experience in the railroad industry shows that most railroad firms operate as integrated firms, the Class 1 freight companies in the US to a similar extent as the regional passenger companies in Japan. The experience from other industries confirms this view. There is a huge variety across countries concerning the deregulation policies of network industries, and in particular, conncerning the separation or integration of upstream and downstream activities. British Gas was fully privatized as a vertically integrated firm in 1986, but provisions were taken to facilitate entry (access price regulation, marketshare cap). In the US electricity market, regulatory power resides at the state level. Across states there coexist many regimes from vertically integrated monopolies to mandatory separation between generation and transmission. In the UK, generation of electricty was separated but vertical integration between transmission and distribution was maintained.

It appears that the desirability of separation of infrastructure from downstream operations is determined by other things than only the concerns for downstream competition. Otherwise, we should indeed see one dominating reform model. There are reasons we have not considered in this paper: Integrated firms may be more efficient because they have lower transaction costs (Williamson, 1987). They also may find it easier to coordinate day-to-day operations or have better incentives for large investment projects (Aghion and Tirole, 1997, Baake et al. 2004). Rather, we have pointed out that even in the absence of these reasons, a regulator may choose to maintain firms integrated for reasons of budgetary constraints.

There are a number of implications of the model for the rail reforms in the EU. First, in our model, as in Vicker's (1995), the so-called "level playing field principle" is not necessarily optimal. Otherwise vertical separation would always be at least as good as integration. Rather, if subsidies are very expensive, regulators may decide to maintain integration, because the integrated firm takes into account the real cost of access c rather than the higher access price a. Notice that the non-level playing field ($a \neq c$) can also play against the incumbent. A "wealthy" regulator who faces small costs of public funds may decide to subsidize access to the bottleneck ($a \leq c$). Lee and Hamilton (1999) extend Vickers model, adding asymmetry in terms of downstream efficiency between the incumbent and entrants. The main insights is that separation becomes more desirable when entrants have lower marginal cost than the incumbent in the downstream segment. This is also possible in our model, but involves more costly subsidies, here for entrants.

The second implication concerns the usefulness of two part tariffs. If a regulator can use two-part tariffs, distortions in the downstream market can be mitigated. Pittmann (2004) has argued before that it may be unwise to forbid price discrimination as this makes it more difficult to cover fixed costs. In our model, not allowing these tariffs would indeed increase subsidies or create the very downstream distortions that regulators try to avoid by assuring discrimination-free entry.

What are the limitations of our simple model? The most important one is that we have not looked at the role of asymmetric information. When the cost of access is private information of the upstream firm, vertical separation may be more desirable. To see why, consider that only the incumbent knows the true costs of access. According to the revelation principle of incentive theory, the regulator has to elicit this information in order to optimize social welfare. However, the owner of the bottleneck asset would like to increase profits from selling access and hence would want to overstate costs. The regulator hence must leave the incumbent firms some rents to reveal the true costs. Under vertical integration these rents are larger than under separation. Here, the incumbent would like to further overstate the true costs of infrastructure in order to increase his downstream competitor's costs, and hence be, himself, more competitive.[10] An optimal regulatory contract thus has to leave larger rents (larger transfers) to an integrated firm than to a non-integrated infrastructure provider. This makes access more costly, and hence there is less quantity downstream. Put differently, asymmetry of information may bend the trade-off in favor of vertical separation.

The trade-off we point out is nonetheless still present, unless informational rents are too large. If the additional informational rents that the regulator needs to pay to an integrated firm are very large, separation may not only dominate from the point of view of increasing competition, but also from a budgetary point of view. Informational rents increase with the uncertainty about true costs. It is hence important to increase cost transparency, which has been one of the goals of the 1991 EU Directive. National railroad companies had to separate the accounts for infrastructure from the ones for operations. Most of the firms have implemented separate accounts in the meantime. This does not eliminate information asymmetry altogether, but it certainly mitigates the problem.

The model has more implications for the current reform discussion in the EU. It is often believed regulators can kill two birds with the stone of more intramodal competition: First, by stimulating competition, more traffic would use railroads rather than roads, which would be good for the environment (and consumers). Second, more competitive pressure would force incumbent rail operators to be more efficient, and would hence reduce the burden railroad cause for the budget of the EU member states.

Our model sheds doubt on this belief. Stimulating competition may involve more rather than less subsidies. However, intermodal competition does not have the same kind of negative budgetary consequences. Throughout the last few years there has been massive entry of low-cost airlines in Europe and a recent case study shows that this had massive effects on the market for rail transportation as well (Friebel and Niffka, 2004). Given that *intermodal* competition seems to be quite effective, it is an important question whether it is socially valuable to increase subsidies in order to increase *intramodal* competition.

Finally the model also has interesting implications for emerging economies such as Russia. The Russian reform plan builds on similar blocks as reforms in the EU. In particular, it stipulates the separation of infrastructure from operations in order to increase competition. There are a number of reasons to be sceptical about this plan (see Cheviakhova et al., 2004). In particular, Russia is dependent on rail transportation to a much larger extent than any EU country: railroads account for close to one half of the passenger traffic and close to 80% of freight. In the light of our model, there is an additional concern about the usefulness of the experiment "infrastructure separation". This concern is related to the fact that the fiscal performance of Russia is low, that is, the costs of raising public funds are high. It may turn out that separation of infrastructure from operations would indeed involve a reduction of traffic or the necessity to increase subsidies (or both). The consequence would be to accept for railroads what has happened in many industries in transition economies: double marginalization and output fall.[11] As the Russian government may find it even harder than the EU to raise additional

[10] In an oligopoly model like ours, the profits of one firm are increasing with the marginal cost of the rivals.

[11] Blanchard and Kremer (1997) call this "disorganization".

public funds, it may be even harder to correct such an outcome. The benefits of maintaining integration may hence be larger than usually expected.

Part 2

Vertical Integration in the Rail Industry: What can Economics Teach Us?[12]

[12]I thank Jacques Crémer, Markus Ksoll and Michael Raith for their comments. All errors are my own.

5. Introduction

In railways as in many other network industries, liberalisation and privatisation involve an important question: should one separate infrastructure from operations, or should the components of the value chain remain integrated, at least for the main national operator? As so often in economics, there is not one single, correct, answer to this question. Experience shows that there is a wide range of institutional solutions, but in many industries and countries, integration appears to be the predominant organisational solution (Knowledge Center Amsterdam, 2003). This is particularly true in the railroad industry; in most parts of the world, railroads are vertically integrated companies (Cheviakhova et al, 2004). However, in Europe there is an ongoing discussion about the costs and benefits of vertical separation. In Germany, the issue is particularly interesting and important. German Government plans to privatise Deutsche Bahn in the near future, but it is an open question whether operations will be privatised in an integrated way, i.e. together with infrastructure, or in a separated way.

Economic theory tells us that the decision of separating infrastructure from operations depends crucially on two potentially conflicting forces. On the one hand, integrated firms may abuse market power. In particular, competitors of, say, *Deutsche Bahn* may fear that an integrated firm does not provide them with access to tracks in a fair, that is, non-discriminatory way. On the other hand, coordination of economic activities may be more efficient in an integrated firm. This is related to the idea that it is costly to coordinate economic activities by contracts across the boundaries of the firms, and that coordination within the boundaries of the firm can be more efficient.

This paper focuses on this second argument, which is the subject of transaction cost economics and was pioneered by Coase (1937) and Williamson (1971). The goal of the paper is twofold: first, to review theory and empirical work in transaction cost economics that is relevant for evaluating the potential coordination benefits of vertical integration; second, to provide a framework for identification and presentation of case studies from *Deutsche Bahn*.

I first describe the analytical and conceptual framework of transaction cost economics. Section 6 argues that the formalized theoretical literature has much concentrated on the capacity of different ownership forms to provide investment incentives. However, day-to-day coordination and adjustment processes may be equally important as investment incentives. This point, which is also present in Williamson's original writing has recently received more attention by a growing theoretical literature on vertical integration, which we look at in Section 7. It may be particularly relvant for an industry like railroads, with its complex technology and the large number of actors involved. Detailed and well-structured cases could contribute to the scientific discussion and help generate better knowledge about the benefits of infrastructure integration. To get some inspiration for such case study work, Section 8 briefly reviews relevant empirical work from other industries that tries to test transaction cost economics.

6. Transaction cost economics: origin, concepts, insights

Transaction costs economics goes back to the famous, Nobel-prize winning article of Coase (1937). Coase introduced the idea that – in contrast to what is assumed by neo-classical economics – the coordination of economic activities through the price system and in the market place is not costless. More precisely, he identifies two major sources of costs of coordination in the market: a) discovering what the relevant prices are (*ex ante* learning); b) the "costs of negotiating and concluding a separate contract for each exchange transaction which takes place on a market" (page 390). According to Coase, the allocation of authority through vertical integration can help firms to save on the costs of b), that is, the costs of agreeing on the terms of trade of a good ("by forming an organisation and allowing some authority to direct the resources, certain market costs can be saved"). On page 391, he defines authority: "a factor (a worker, for instance, GF) agrees for a certain remuneration to obey the directives of an entrepreneur within certain limits." He also points to the cost of organisation in particular the diseconomies of scale in administration, and the risk of potential misallocation of authority.

Williamson (1971) and his following work develop these thoughts further towards a modern theory of the firm. Williamson identifies three forces that cause transaction costs. First, individuals are subject to bounded rationality – they are limited in their capacity to foresee and plan for the future. Hence contingencies may arise that have not been planned for in a contract. Second, there are limits to communication between economic agents; this also imposes constraints on the completeness of contracts. Third, even if the first two problems could be overcome, there are limits to which a third party (a court or a mediator) would understand the agreements between two parties, making it difficult to enforce these agreements according to the initial understanding of the contracting parties.

In the presence of transaction costs, contracts are necessarily incomplete. Consider that two parties find themselves in a situation ("state of nature") about which the contract is silent or unclear. Consider further that there is value in staying in this relationship, but the contract does not stipulate how this value ("surplus") should be shared. We then talk about a situation of *ex post* (that is after the parties have contracted an potentially invested in a relationship) quasi-rents. These quasi-rents may give rise to the so-called hold-up problem: one or both parties have incentives to "haggle", i.e. to invest effort and resources to acquire a larger share of the surplus. This is certainly inefficient as it diverts the parties' attention from more productive use, delays agreements etc.

Williamson argues that "internal organization attenuates the aggressive advocacy that epitomizes arm's length bargaining" and introduces the term "intraorganizational settlements by fiat (=authority, GF)". He believes that fiat is frequently a more efficient way to settle conflicts than haggling and litigation. In a nutshell, managers through their authority in firms can be more efficient arbiters than judges. However, there are costs of vertical integration, in particular that incentives in firms are usually weaker than the incentives the market provides.

Williamson and related scholars have then further developed this positive theory in order to explain why certain structures have evolved and why enforcement within the boundaries of firms can be more efficient (less costly) than across the boundaries of firms. While we are far from having a final answer to this question, it is probably fair to say that in the opinion of transaction cost economics, vertical integration would be more likely to be efficient if the quasi-rents are bigger (that is, when investments are rather specific to the relationship of two or more parties), when transaction between two or more parties are frequent, and outcomes are more uncertain (see Section 8 for a short overview on empirical work).

One of the arguable weaknesses of transaction cost economics has been its lack of formalization. It is hence not surprising that the so-called property rights theory of Grossman and Hart (1986) and Hart and Moore (1991) has had major success, as it takes up the idea of incomplete contracts and provides elegant models of the effect of ownership on efficiency. Here, ownership (property rights) are seen as a way to allocate decision rights that are not stipulated by contract ("residual rights of control").

The theory posits that *ex post* any two parties will always manage to agree to maximize the surplus associated with their relationship. The parties involved bargain *ex post* over the surplus that is associated with their relationship (the quasi-rents) and they do so in an efficient way; none of the surplus is destroyed in the process of negotiations. The allocation of bargaining power between two parties, however, depends on who owns the assets; the party that is the owner can threaten to withdraw the assets from the relationship, making it possible for them to acquire larger parts of the surplus.

While different ownership agreements are hence neutral with respect to *ex post* efficiency, they do have an impact on *ex ante* efficiency. At the time when two parties enter a contract and when ownership entitlements are allocated (e.g., party A sells an asset to party B), both parties anticipate the possibility of *ex post* bargaining. The parties also anticipate that the party who is the owner of a certain asset will have more bargaining power in those states of nature the contract is silent about. However, if in a subset of situations, the owner will acquire more of the surplus, and the party that does not own assets less, then the incentives of the non-owner to invest in the asset will be smaller and the investment incentives of the owner will be larger, compared to a situation of joint ownership. Ownership hence provides incentives to parties, and its allocation should depend on the importance of various parties' inputs and efforts. In general, we would expect that the more important a party's effort, the more likely it should be to have ownership rights.

7. Investment incentives or day-to-day coordination and adjustment?

Much of the theoretical literature following Grossman and Hart (1986) and Hart and Moore (1991) have focused on the question how ownership arrangements can mitigate the *ex ante* problem of underinvestment. However, Whinston (2003) argues convincingly that it is hard to empirically test the predictions of the property right theory concerning *ex ante* incentives. It is hence not surprising that more recently, a number of authors have advocated a shift of theorists' attention back to the *ex post* costs as determinants of vertical integration.

Three recent papers further build on these insights and discuss issues of ex post coordination and adjustment: Gertner (2002), Wernerfelt (2004) and Gibbons (2004). Gertner (2002) looks at a situation in which two units produce inputs that can be combined to a certain output. There are *ex ante* unforeseen or indescribable events. If such an event occurs, the most valuable output can only be produced if both inputs are provided. If the two units are independent firms, one of them may then have an incentive to haggle: they may spend resources on trying to appropriate a larger share of the output, threatening to otherwise use their input for production of the initially agreed upon type of output. In this situation, vertical integration can be helpful. If the two units are not independent firms, but divisions of the same firm, top management can use his authority to prevent such haggling. The problem with the argument is, of course, that both division managers may try to influence top management's decision, a problem that has been analysed by Milgrom and Roberts (1988, 1990). Ultimately, as Gibbons (2004) points out, one would hence need a more general theory that would allow comparing the costs of haggling within and across the boundaries of firms.

Wernerfelt's (2004) paper builds on the simple insight that parties can choose how to govern adjustments of their (production, consumption or supply) plans. He compares three potential adjustment mechanisms: first, negotiation of adjustments when they come up; second, advance agreement how to handle future adjustments; third, agreement to leave the stipulation of adjustments to one of the two parties. While the first mechanism can be understood as a spot contract, and the second as some binding long-term contract, the third one builds on the notion of authority. Here, one party transfers their authority of handling adjustments to another party. For instance, one party, say "the worker", may sign an employment contract with another party, "the manager", or a firm's owner may sell his assets to another firm that will then have authority about what to do with the assets.

Rather than presenting a fully closed and resolved model, Wernerfelt's paper provides a broad discussion of the costs and benefits of authority in deciding on adjustment. For our purpose, the most important point is that under vertical integration, adjustments will be taken faster and will fail less often. This is intuitively clear, but also supported by an important finding from bargaining theory: Myerson and Satterthwaite (1983) have shown that bargaining between two parties may fail if both parties have private information, i.e., if there is a situation of bilateral information asymmetry. Giving one party authority over adjustment decisions, rules out this kind of bargaining break-down because the parties cannot agree on what to do. In terms of the costs of authority allocation (vertical integration), Wernerfelt is less explicit. In particular, he points to the potentially lower incentives.

Finally, Gibbons' (2004) paper provides an interesting overview of a number of transaction cost theories of vertical integration we have discussed above (property right, adjustment, rent-seeking). Most interestingly, he argues that ultimately, theory would have to take to account that it is a short-cut to assume that haggling (rent-seeking) between two economic agents would occur only between two non-integrated firm. Rather, one would have to take into account the activities of agents within a firm to influence an internal decision-maker, say, the CEO. This has been subject of the papers by Milgrom and Roberts (1988) and (1990), and Gibbons suggests a model that could compare the relative efficiency of integrated vs non-integrated structures in dealing with these inefficiencies. However, he does not provide a full solution, nor does he generate interpretable and testable results.

We can conclude that the literature seems to take a sharp turn and has refocused on the *ex post* problems of haggling and maladjustment that could be quite interesting for railroad economics. One should understand that we are quite far from having one clear and generally accepted theory, but theory provides us with inspiration to identify the most original and challenging case examples.

8. Empirical work

There are a number of by now classical papers that have attempted to test the predictions of transaction cost economics. Whinston (2003) discusses three of them: Monteverde and Teece (1984) look at the decisions of Ford and GM to have external suppliers produce car components, or to produce them in-house. They find evidence corroborating the view that transaction costs are important. In their sample of 133 components, components that are very specific, i.e., that can be used seldom outside GM or, respectively, Ford are more likely to be produced in-house. Similarly those components that involve more development effort by engineers are produced in-house, presumably to mitigate the hold-up problem. Masten (1984) looks at 1,887 components that are used by a large aerospace manufacturer and finds that more specialized components and more complex components are produced in-house. Joskow (1987) finds that electrical utility companies tend to have more long-term relationships when coal mines are co-localized with the utilities, and alternative coal suppliers are remote. Similar results from coking factories have been obtained by Goldberg and Erickson (1987).

There is hence indeed support for the ideas of Williamson and other transaction cost economists that there are benefits in vertical integration and long-term contracting when specificity is high and there are thus large quasi-rents and when contracting is complex.

Gertner and Stillman (2001) offer an interesting additional perspective on the benefits of vertical integration. They investigate to what extent different firms in the apparel (garment) industry were able to make use of the innovation "internet". They show that firms that were vertically integrated, that is, owned their own distribution channels and retailers, managed to make use of the internet swifter, had deeper and broader coverage, received better rankings for their website and had more visitors than firms that were not integrated (for instance, department stores and vendors). This result needs to be taken with a grain of salt, because one cannot derive estimates of efficiency from quantitative or qualitative internet performance indicators; for instance, it may be that integrated firms were just willing to invest more money in their internet sites. Nonetheless, the results are interesting and in line with some theoretical arguments. Gertner and Stillman identify three potential reasons why vertically integrated firms may have outcompeted other firms in their use of the internet.

First, firms that are not vertically integrated have "channel conflicts", that is when they decide to use the internet, they may get into conflicts with retailers of department stores who fear additional competition. An integrated firm can handle these conflicts in-house, and decide to look at the net effect of internet expansion only, rather than having to argue with business partners whether or not the internet would be too much competition for traditional retail channels.

More relevant for railroads are "externality problems". A study of McKinsey (cited in Gertner and Stillman) shows that the average gross margin on on-line sales for manufacturers was 46% in 1999, while it was only 9% for multi-label retailers. They hence have a lower incentive to invest in the internet. The problem is exacerbated by the fear of free-riding. If a manufacturer invests in an internet distribution channel that it does not own, and that is also used by other manufacturers, it fears that competitors benefit, which reduces its investment incentives. Finally, Gertner and Stillman point to coordination costs: in the absence of these and other transaction costs (in particular those owing to information asymmetries), none of the above would be a problem as one could write agreements between the different parties making sure that the joint surplus of different manufacturers and retailers were maximized. However, when coordination costs are substantial, these agreements fail to be taken or they are sub-optimal.

9. Concluding remarks: the value of case studies

Economists have been interested in vertical integration for quite a while. In his nobel-prize winning article Coase (1937) pointed to the importance of transaction costs. Contracts need to be written and enforced, and this is rarely costless. In railroads, for instance, similar conflicts may emerge as the ones analysed by Gertner and Stillman (2001): To provide but one example, when many railroad companies operate on the same network, who should pay the fine when there are delays? It is not by chance that economists have often looked at railroads as examples of successful vertical integration. The most famous example is Chandler's book on the managerial revolution in the US (1977) in which he argues that railroads were the first industry in which the modern corporation emerged. While top management took care of financial issues and investment, professional middle management emerged in order to coordinate complicated transport flows over a steadily increasing rail network. Recent empirical work from other industries shows that it is most interesting to exploit variations over time and across sections, i.e., to use panel data sets. Friebel et al. (2003) investigate the effects of railroad reforms on efficiency in a panel of European railways over more than 20 years. We find that in general reforms have improved efficiency of European railroads, but that nothing meaningful can be said about the effects of infrastructure separation.

The problem with the design of empirical work on the costs and benefits of vertical integration is that in railroads there are to date few firms per country. Hence, few observations are available. When there is such a lack of data, it can be useful to look at in-depth case studies that can help in highlighting the differences in coordinating adjustment efforts within and across the boundaries of the firm. Some examples of such problems are the measurement of wear and tear of tracks or the reduction of noise, the prevention of accidents, upgrading of trains and infrastructure, to name but a few.

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