Open Access Competition and Rail Franchises: A Simulation Model Applied to the East Coast Main Line

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1 *INTRODUCTION*

The passenger railway industry in Great Britain has now been transferred into the private sector in the form of individual monopoly franchises. The introduction of open access competition, whereby operators are allowed to compete with franchise holders on all or part of their networks, is now not expected until well into the next century.

This paper reports on the application of an equilibrium simulation model to open access competition on a sub-section of the former East Coast Main Line (ECML) now Great North Eastern Railways (GNER). The model derives optimally scheduled services and fare levels for up to three train operators, who adopt Cournot conjectures with regard to the operating actions of their rivals. This paper does not intend to describe the model in detail but deals mainly with the results of the simulation exercises.

2 *THE MODEL*

The model is an equilibrium simulation model. When there is only one operator in the market, it derives optimal service schedules and fares through the maximisation of the operator's objective function (profit). When there is more than one operator in the market, optimal service schedules and fares are derived for each operator, with reference to the services and fare decisions of its rivals as well as its own objective function.

Each train operator possess Cournot conjectures concerning how their rivals will react when they reschedule their services or alter any of their fares. Each Cournot operator is therefore characterised as maximising

$$\pi_j = \pi_j(r_j^c(q_k), q_k) \qquad (1)$$

where $r_j^c(q_k)$ is the Cournot reaction function of operator j. Cournot's analysis involves a *symmetric pre-market process* which, when followed through to its end, yields the observed market decisions of the firms.

The pre-market process is simply offered as a method of solving a system of equations and economic questions about the out-of-equilibrium adjustment process and properties of its convergence are left unresolved. It is frequently noted, as a criticism, that the firms in the Cournot pre-market process behave in an unusual manner out of equilibrium. At every stage of that behavioural process each assumes that its rivals will not react, although this conjecture is repeatedly shown to be false. In this sense it is said that Cournot firms have no capacity for learning from past misconjectures. While the Cournot adjustment process has this troubling aspect out of equilibrium, it is important to note again that the sole purpose of the pre-market process and reaction functions is to provide an analytical procedure for deriving the equilibrium and *not* to describe an *actual* sequence of behaviour. Thus, any perverseness in the pre-market process is to be viewed simply as a property of the technique used to solve the oligopoly problem and not of any economic importance. More particularly, any such perverse behaviour does not invalidate Cournot as a *solution* (or *equilibrium*) concept.

The model determines Cournot-Nash equilibrium fares and services, and resultant profits for each operator in the market. Specifically each operator will maximise the profit function

$$\pi_j = \pi_j\{S,F\} \qquad (2)$$

where $\boldsymbol{S}$ is a vector of all scheduled services operating over the route, and $\boldsymbol{F}$ is a vector of the fares charged by each operator.

The solution procedure to derive Cournot-Nash equilibrium service schedules and fares is derived via a two-part process. The first part involves deriving a vector of service schedules $\{S\}$. The second part involves calculating the optimal (Cournot-Nash) fares for that particular vector of service schedules. By examining every vector of services $\{S\}$ and a unique vector of fares $\{F\}$ for each the computer is able to select the highest-profit combination, which by definition is our optimal service-fare vector. Consider a single operator j with a vector of services $\{S_{j1}\}$ and a corresponding optimal fares vector $\{F_{j1}^*\}$. If $\pi_j(S_{j1},F_{j1}^*)$ is greater than a previous combination $\pi_j(S_{j0},F_{j0}^*)$ then $\{S_{j1}\}$ and $\{F_{j1}^*\}$ become local optima. Only after every combination has been checked and the associated fares vectors calculated can the global optimum be determined. If $\pi_j(S_{j0},F_{j0}^*)$ remains the highest profit vector of services and fares then it is also the global optimum $\pi_j^*(S_{j0}^*,F_{j0}^*)$. The model optimises the service schedule vector for every combination of services, northbound and southbound, simultaneously.

When more than one operator can operate services in the market, the solution procedure remains the same, with the only restriction that new operators cannot schedule a service at a time where a service already exists. The computer determines the maximum number of possible departure times of services between existing services, limited by the minimum headway that is permissible between services.

When the equilibrium profit for the new operator given its Cournot conjectures has been determined, the incumbent operator has the chance of rescheduling any of its services and the level of its fares again. It now knows the service pattern and fares of the entrant operator and so the same solution procedure is performed adopting Cournot conjectures. The sequence continues until both operators, or all operators in the market, are at jointly determined equilibriums and so do not find it profitable to change their operating variables.

The optimal configuration configuration of service schedules will depend in part on the profile of demand throughout the day. Demand profiles for each origin and destination were derived from train passenger counts and survey data specific to the route (see Section 3). An important conceptual issue is the assumption that a user has only one ideal time of departure, and this time does not depend on the actual services offered but on the real reason to travel. Users suffer reductions in utility if they have to travel at a time different from their ideal, although they are *not* changing their ideal time. Rather than model each individual passenger the day was divided into a number of time slices with the centre of each slice representing the ideal times of each and every passenger having an ideal time of travel within that slice.

Each time slice possesses its own demand model:

$$Q_{j,c,t} = \alpha_{j,c,t} \exp(\beta_{j,c,t} GC_{j,c,t} + \sum_{k=0}^{K} \beta_{j,c,k,t} GC_{j,k,t}) \qquad (3)$$

where the composite cost of travelling is given by

$$GC_{j,c,t} = \frac{1}{\theta} \ln \sum_{s=0}^{S} \exp(\theta GC_{j,c,t,s}) \qquad (4)$$

There are no cross-elasticity effects between slices because each represents an ideal time of travel, which is dependent upon the underlying reason to travel and not the level of service. The proportion of total demand in each slice (*t*) with journey purpose (*j*) and using ticket type (*c*) is allocated to individual services using a single level logit model

$$P_{s/j,c,t} = \frac{\exp(\lambda GC_{j,c,t,s})}{\sum_{s=0}^{S} \exp(\lambda GC_{j,c,t,s})} \qquad (5)$$

where the generalised cost of travelling by journey purpose (*j*), ticket class (*c*), with an ideal time of travel (*t*) and travelling on service (*s*) is given by

$$GC_{j,c,t,s} = P_c + \alpha_j T_{c,t,s} + \beta_j W_{c,t,s} \qquad (6)$$

where P_c is the fare, $T_{c,t,s}$ is the total travel time for the journey and $W_{c,t,s}$ is the time difference between actual and ideal departure or wait time. The parameter values α_j and β_j are values of time for journey purpose (*j*).

The scaling parameters used in the logit model were derived iteratively during calibration. Scaling parameters were assumed constant across time periods.

3 *THE CASE STUDY*

The Leeds-London service group is that group of services within the old ECML profit centre which linked Leeds/Bradford/Harrogate with London Kings Cross. Passengers using any other services on the route are excluded. Thus, only passengers using Leeds-London service group services are included in the market demand. All those using other services, *even* if a Leeds-London service group service is an alternative for them, are excluded. Thus, passengers who used other ECML service group train services, such as a southbound Newcastle-London service from Doncaster, are excluded from the market demand.

The market demand would include passengers whose origin or ultimate destination lies away from the route but use the group's services as part of their overall journey. For example, a journey from Ilkley to Gatwick Airport would normally involve the use of a Leeds-London service in the middle part of the journey, and so passengers making this journey would be part of the market demand.

The real network operated over by the service group contained 13 stations (Harrogate, Bradford, New Pudsey, Leeds, Wakefield Westgate, Doncaster, Retford, Newark Northgate, Grantham, Peterborough, Huntingdon, Stevenage and London Kings Cross). We reduced this to a simplified network of 7 stations (Leeds, Doncaster, Newark Northgate, Grantham, Peterborough, Stevenage and London Kings Cross) to reduce the complexity of the case study.

Real train operations involve sharing resources with other ECML services, and even other profit centres. For instance, ECML employs its own drivers based at Kings Cross and Newcastle, but bought in drivers from Leeds, Edinburgh and Doncaster. In addition, ECML bought in maintenance and servicing from InterCity Cross Country at Neville Hill (Leeds) and servicing from Regional Railways at Heaton (Newcastle). Such a complex sharing of resources has been simplified in the base situation so that we have modelled the Leeds-London service group as a self-standing network with completely dedicated rolling stock, depots and maintenance facilities. While this simplifies costing it does set constraints over the variations of timetables that can be physically operated with a given number of train sets.

The diagramming of a timetable will lead to a certain amount of empty running by train sets. This will be because a train set has terminated at a different point on the route to where it departs next day, and so needs to return to the point in question. In addition, and more commonly, some train sets are stabled overnight in readiness for the next day (and for overnight servicing) and so need to "empty run" to the terminal the next day. The base situation models any empty running that results from a diagrammed timetable but does not model the empty running from depot to terminal. There is also a minimum turnaround time at terminals before a train unit can depart. This time is used for any necessary train maintenance, the loading of supplies for the buffet cars, and any cleaning of the cars that needs to be undertaken.

Since demand flows are variable across the week a different timetable is sometimes operated on weekdays and weekends. Accurate modelling would include modelling the whole week, with special timetables for Saturday and Sunday. This would involve running the model three times, once for Monday to Friday, and once for each of the weekend days. However, such repetitive modelling was unnecessary for our requirements and it was decided to model an average Monday to Friday timetable. Rather than assume that this situation would last seven days a week, all calculations are based on a six day week.

The structure of tickets available for travel on InterCity services is extensive. However, we have adopted a simplified fares structure consisting of first class full single, and second class standard single and saver single. The restrictions governing saver ticket use have changed regularly and are under constant review. We have chosen to adopt a simplified version of the restrictions which existed with the base timetable. Essentially, saver tickets are restricted on the 0715 and 0745 from Leeds for travel beyond Peterborough, and on the 0750, 0850, 1650 and the 1755 services from London, for travel starting at London.

Services between Leeds and London are operated using IC225 train sets, and 125HST train sets when the service originates from Harrogate or Bradford. In addition, there are different configurations of First class and standard coaches. For instance, there are large Pullman sets (3 First class, 4 standard, 2 service vehicles), normal Pullman sets (3 First Class, 5 standard, 1 service vehicle) while the large majority of sets are formed with 2 First class and 6 standard cars, plus one service vehicle. At all times in our modelling process we consider that the latter formation is used. Detailed operating cost information for both rolling stocks was used in the model.

Services operated by other ECML service groups, other profit centres and other Business Units that use sections of the ECML route along with the Leeds-London service group have not been included in the base situation. While such services are not relevant for our main Leeds-London flows, they carry significant flows between intermediate stations. As a consequence, estimates of incremental revenue will be biased because an unknown part of the revenue change will actually come from passengers switching from other ECML (and BR) services.

4 RESULTS

In this section we will present the results from our computer simulation model which determines equilibrium outcomes for the Leeds-London market operated as if it were a separate franchise. The outcomes are insightful, not only in comparison with the base situation used for calibration, but also as a source of comparison across competitive scenarios. We have, however, concentrated our attention upon whether there is scope for open access competition and if so, what form should it take. All figures presented are in 1992 prices. All fares represent average single fares for the route as a whole.

4.1 Monopoly Franchises

The only operator of services in the Leeds-London market is the franchise holder. In the first instance, the Franchise Director does not lay down any timetable restrictions or establish any fare restrictions on the franchisee. Thus, the franchisee can be considered as an unrestricted profit-maximising (monopoly) operator. In the second instance, we examine what happens when the Franchise Director insists (a) that the franchisee must operate the 1994 timetable, and (b) that the franchisee must operate at least one service an hour. In all cases, Railtrack uses a multi-part charging tariff with some elements fixed irrelevant of usage, and others variable with usage.

4.1.1 An Unregulated Franchisee

Let us assume that the franchisee can set what fares it wishes and what services it wants to operate. Economic theory would suggest that a profit-maximising operator faced with no competition would increase fares and reduce services leading to supernormal profits, when compared to a perfectly competitive equilibrium. We find that with a profit-maximising franchisee, revenues increase (+22%) due to large fare increases, costs fall (-4%) due to the reduction of 21% in the number of scheduled services operated from 28 to 22 per day, and resultant profits rise (+41%). Thus, the model is consistent with economic theory in this respect and the overall situation is presented in Table 1.

TABLE 1 UNREGULATED FRANCHISEE

	Base	Franchisee
Northbound services	14	11
Southbound services	14	11
Revenue	£62.6m	£76.2m
Costs	£27.0m	£25.9m
Profit	£35.6m	£50.3m
Consumer Surplus	£75.8m	£69.7m
Welfare	£111.4m	£120.0m

An interesting measure is that of consumer surplus, measured in terms of generalised cost rather than simply fare. While the base situation in no way represents a pareto optimal position it is closer to a competitive outcome than the profit-maximising franchisee, with fares being lower and more services operated. Consumer surplus in the base situation amounts to some £75.8m, whereas in the profit-maximising case it falls to £69.7m indicating that rail users are worse off with such a situation. Total welfare is the sum of consumer surplus and producer surplus (profit). We find that welfare under a profit maximising unregulated franchisee is higher than the base by some 8%.

With respect to fares, in general we find that average first class and second class full (standard) fares rise above the base situation, by some 72 per cent and 36 per cent, respectively. On the other hand, we find that average second class reduced (saver) fares remain roughly at the base level, rising by only 1.5 per cent. Average single fares for the market are displayed in Table 2.

TABLE 2 FARES

	Base	Franchisee
First Class	£28.78	£49.62
Standard Class	£18.69	£25.49
Saver Class	£12.14	£12.33

4.1.2 A Regulated Franchise Holder

It is the responsibility of the Franchise Director to establish the level and quality of service within individual franchise areas. Let us consider that (a) the Franchise Director constrains the franchisee to operate the 1994 timetable between Leeds and London; then (b) the Franchise Director forces the franchisee to operate at least one service an hour in each direction over a 13 hour period. In both instances, the franchise holder is free to set fares to maximise profits and pays Railtrack to use its infrastructure through a multi-part tariff.

In Table 3 below we present the profit maximising outcomes for both cases. When operating the 1994 timetable we see that the franchisee is forced to run 18 southbound and 17 northbound services. As a result of having to utilise more train sets, its costs increase quite considerably (by some 26% above what they were under an unregulated franchisee). However, we must be careful here since the 1994 timetable was part of the overall timetable for the ECML and so there would have been greater interworking of train sets. In addition, the timetable and rolling stock utilisation is not jointly determined as before, but instead rolling stock is minimised for a given timetable.

When regulated to operate at least one service every hour, the franchisee performs better than when regulated more extensively (1994 timetable). Its profits increase by some 12% (even though revenue slightly falls) due to a reduction in costs of 20% as a result of operating the base minimum number of services necessary to please the Franchise Director (26 per day). User benefits are greater when the 1994 timetable is operated purely because so many more services are operated. It is interesting to note that the profit and welfare resulting from the operation of at least one service an hour are very close to those experienced by the unregulated franchisee.

TABLE 3 REGULATED FRANCHISEE PERFORMANCE

	1994 Timetable	Hourly Minimum
Northbound services	17	13
Southbound services	18	13
Revenue	£78.5m	£77.3m
Costs	£34.0m	£27.3m
Profit	£44.5m	£50.0m
Consumer Surplus	£73.3m	£70.0m
Welfare	£117.8m	£120.0m

In both cases fares have increased by roughly the same proportion as they did with the unregulated franchisee. However, we can see that single first class fares increase by more on average when a minimum hourly service is required, while single saver fares increase more on average under the 1994 timetable.

TABLE 4 REGULATED FRANCHISEE FARES

	1994 Timetable	Hourly Minimum
First Class	£48.86	£50.22
Second Class Standard	£25.42	£25.36
Second Class Saver	£13.26	£11.98

In conclusion, we can see that with exclusive franchise agreements fares have generally increased above the base level used during calibration. In addition, user benefits, as measured by consumer surplus, have fallen below the base level by between 3% and 8%. This means that passengers are worse off under exclusive franchise agreements than they were under the service and fare pattern operated by the old ECML service group of British Rail. On the other hand, greater industry profits have resulted, rising between 25% and 41% above the base level of profits. There is thus a simple transfer of benefits away from users to operators of rail services. From a welfare standpoint it is best if the timetable specification is not too specific.

4.2 Open Access Competition : Duopoly Outcomes

One of the features of the government's proposals for the railway industry, and a matter at the heart of economic policy in other industries for many years, is the introduction of competitive forces. In the railway industry, it is hoped that this will be realised by the introduction of so-called open access operators who will compete with the franchise holders within the franchise area. There are a number of issues of importance to us here. First, economic theory states that competition leads to an increase in consumer surplus (user benefits) as fares approach the marginal cost of provision and abnormal profits disappear. We will examine whether there is scope for competition in the railway industry and whether these effects are realised. Second, there is concern that the threat of open access competition will lead to minimal interest to operate rail franchises unless protection is given to franchise holders in the way of limited or no open access competition for a certain number of years. We will examine the effect of open access competition on franchisee profits and the degree to which the franchisee can safeguard its profits by altering its services and fares.

4.2.1 An Unregulated Franchisee faced with Open Access Competition

The unregulated franchisee is faced by competition from a single open access operator, who likewise is unregulated. The effect is quite dramatic, as shown in Table 5 below. The franchisee increases the number of services it operates by 6 services per day. Meanwhile, the open access operator runs 24 services per day, leading to an increase in total services operated by 136% compared to the monopoly franchise reported above. These types of increases are very similar to the increases in bus services as a result of duopolistic competition following deregulation. In addition, we find that the franchisee's profits fall by 73% and total industry profits by 49%. Consumer surplus rises dramatically by 47% as fares fall due to the introduction of an open access operator. Thus, competition reduces profits in the railway industry and increases user benefits, as economic theory suggests.

TABLE 5 UNREGULATED DUOPOLY OUTCOMES

	Franchisee	Open Access Operator	Industry
Northbound services	14	12	26
Southbound services	14	12	26
Revenue	£41.9m	£26.5m	£68.4m
Costs	£28.2m	£14.3m	£42.5m
Profit	£13.7m	£12.2m	£25.9m
Consumer Surplus			£111.7m
Welfare			£137.6m

We can see that welfare increases above that experienced under monopoly franchises. The franchisee is allocated all the common infrastructure costs even with another operator is in the market. If the open access operator were allocated more than £12.2m infrastructure costs (at present the franchisee is allocated £11.3m infrastructure and terminal costs) it would be better for the open access operator not to enter the market. We can see in Table 6 that a duopolistic situation results in much lower average fares than under a monopoly franchise.

TABLE 6 UNREGULATED DUOPOLY FARES

	Franchisee	Open Access Operator
First Class	£26.93	£24.55
Second Class Standard	£11.03	£9.26
Second Class Saver	£6.48	£5.61

4.2.2 A Regulated Franchisee faced with Open Access Competitor

The most striking feature when the franchisee is forced to operate the 1994 timetable is that the franchisee makes a loss of some £1.3 million. This is due to the fact that the franchisee is constrained to operate a timetable laid down by the Franchise Director with no ability to reschedule when faced with competition. This has two implications: (a) first, if the franchise holder is made to operate a set timetable then it must receive compensation (additional subsidy) from the Franchise Director. Alternatively, the open access operator could be allocated some of the common infrastructure costs. Infact, the operator could be allocated all of these costs and still make a profit of some £7.6 million, such is the degree to which the franchisee is disadvantaged. Second, since industry costs are higher (+20 per cent) and profits lower (-32 per cent) complete regulation of the timetable by the Franchise Director appears harmful to the industry as a whole.

On the other hand, we find that less restrictive regulation leads to positive profits for both operators. The reason for this is that the franchisee is now able to reschedule its services when faced with competition, as long as it continues to operate at least one an hour. The partially constrained franchisee generates more revenue (+6%) than the franchisee forced to operate the 1994 timetable. In addition, the franchisee has sufficient flexibility to reduce costs partly by scheduling so as to reduce the quantity of rolling stock it needs (it uses a third fewer trains) and ultimately running fewer train-miles. As a result, costs are 19% lower and resultant profits in excess of 600% higher. Industry profits, on the other hand, increase by only 13% compared to full timetable regulation. In comparison with the unregulated duopoly industry profits actually fall by 24% but user benefits, as measured by consumer surplus, rise by 5%.

TABLE 7 REGULATED DUOPOLY OUTCOMES

	1994 Timetable			Hourly Minimum		
	Franchisee	Open Access	Industry	Franchisee	Open Access	Industry
Northbound	17	14	31	13	13	26
Southbound	18	14	32	13	13	26
Revenue	£32.6m	£36.0m	£68.6m	£34.6m	£27.9m	£62.5m
Costs	£33.9m	£17.1m	£51.0m	£27.5m	£15.2m	£42.7m
Profit	(£1.3m)	£18.9m	£17.6m	£7.1m	£12.7m	£19.8m
Cons Surplus			£109.8m			£117.0m
Welfare			£127.4m			£136.8m

Total welfare increases in both cases compared to that experienced under regulated monopoly franchises. However, as before, less restrictive regulation results in higher welfare, by almost as much as that experienced under the unregulated duopoly arrangement.

We find that with the introduction of an open access operator the franchisee reduces its fares quite considerably, similar to the unregulated duopoly case. However, when forced to operate the 1994 timetable fares do not fall as much as when forced to operate at least one service an hour because more services are being operated and the higher fares are required to pay for this arrangement. Average single fares for each scenario are presented in Table 8 below.

TABLE 8 DUOPOLY FARES

	1994 Timetable		Hourly Minimum	
	Franchisee	Open Access	Franchisee	Open Access
First Class	£24.72	£22.46	£21.00	£20.53
Standard Class	£14.14	£12.26	£9.13	£7.87
Saver Class	£7.52	£6.85	£5.64	£5.33

4.2.3 Open Access and Product Differentiation

In this section we consider that the open access operator does not enter using HST 125 trains but rather uses 4 car Class 321 electric multiple units (maximum 307 seats), which are presently used on the Leeds-Doncaster route by Regional Railways North East. The situation is analogous to minibuses competing with single and double deck bus operators in the bus industry. In addition, we will assume that the operator offers only standard class travel, which we will refer to as "club class". Thus, we have an example of two operators offering quite differentiated products. On the one hand, we have a franchisee offering high speed travel and a choice of three tickets while, on the other, we have an open access operator offering only "club class" travel and a slower service (the maximum speed of a Class 321 unit is 100mph, which is an average 25% slower than a HST125 unit).

The franchisee is allocated all common infrastructure costs and must operate at least one service an hour as before. When compared to the comparative regulated duopoly case above we find that the franchisee performs much better, increasing its revenue by 73% and its profits by 360%. The open access operator, however, would experience 40% lower revenue and 37% lower profits than if it operated HST 125 train units, inspite of a reduction in costs of some 43%. However, both operators make positive profits. At industry level, revenues increase by 22%, costs are down by 16% and resultant profits up by 105% as shown in Table 10 below.

TABLE 10 DIFFERENTIATED DUOPOLY OUTCOMES

	Franchisee	Open Access Operator	Industry
Northbound services	13	13	26
Southbound services	13	13	26
Revenue	£59.8m	£16.7m	£76.5m
Costs	£27.2m	£8.7m	£35.9m
Profit	£32.6m	£8.0m	£40.6m
Consumer Surplus			£76.6m
Welfare			£117.2m

Thus, the Rail Regulator could protect the interests of the franchisee, in terms of higher profits, and still encourage entry by forcing new operators to differentiate their products substantially from the franchisee's, such as the introduction of "club class" competition.

We can see user benefits are lower than the previous case by some 35%. The reason for this is that faced with no competition on its first class fare the franchisee raises it some 161% above the regulated duopoly case. The franchisee faces only direct competition on its standard class fare, although strong cross-elasticity effects still exist between the standard and saver fares. Welfare is also lower than with the comparative duopoly outcomes again because of the higher fares.

Overall, we can see that differentiated product competition results in a higher fare equilibrium than if the operators offer the same product to users. In Table 11 below we can see that average single standard fares are 141% and 134% higher for the franchisee and open access operator, respectively, while saver fares are on average 150% higher for the franchisee.

TABLE 11 DIFFERENTIATED DUOPOLY AVERAGE FARES

	Franchisee	Open Access Operator
First Class	£54.72	
Standard Class	£21.99	£18.43
Saver Class	£14.12	

This scenario generates more industry revenue, which could be used for investment in the industry, than the previous duopoly case, while still promoting competition. However, the increased revenue is gained at the expense of users.

4.3 Open Access Competition : 3-Operator Outcomes

So far we have considered entry by a single operator to compete with the franchisee. However, the profits gained by the open access operator are likely to lead to further entry as other operators are attracted into the industry by positive profits. Thus, we now turn to examine two situations where three operators compete in the market.

First, we will consider entry by another open access operator who, like the first, uses 125 HST train units. The franchisee is forced to operate at least one service an hour, as before, and uses IC 225 rolling stock. The results presented in Table 12 suggest that entry is not sustainable by a third operator and the franchisee also experiences negative profits. The first open access operator, however, continues to make positive profits.

TABLE 12 THREE OPERATOR OUTCOMES

	Franchisee	Open Access 1	Open Access 2	Industry
Northbound services	13	13	10	36
Southbound services	13	13	10	36
Revenue	£21.9m	£16.6m	£12.5m	£51.0m
Costs	£27.4m	£15.0m	£12.7m	£55.1m
Profit	(£5.5m)	£1.6m	(£0.2m)	(£4.1m)
Consumer Surplus				£131.3m
Welfare				£127.3m

We can see that the Franchise Director would have to provide financial support for the franchisee in this case, and some support given to the second open access operator as well. The advantage is the high value of consumer surplus which results from the large number of services operated and, more importantly, the low fares that resulted as each operator strove for greater market share. The negative industry profits, however, means that total welfare is less than the value of user benefits. Compared with other duopoly outcomes the three-operator case is welfare-inferior, although only marginally with the 1994 timetable duopoly.

The impact on average single fares resulting from entry by another open access operator is presented below in Table 13. The average fares for the second open access operator are much lower than the fares of the first two operators because they possess the most profitable trainpaths. The sequential nature of selecting trainpaths meant that the second open access operator possesses the worst paths since it is effectively last on "the grid". To attract users onto its services it had to lower its fares that much more.

TABLE13 THREE OPERATOR FARES

	Franchisee	Open Access 1	Open Access 2
First Class	£12.75	£12.70	£7.74
Standard Class	£7.63	£6.26	£5.04
Saver Class	£4.29	£4.11	£3.29

Now let us consider that the two open access operators operate their services using 4 car Class 321 electric multiple units rather than HST 125 trains, and offer only "club class" travel. The most important outcome from this scenario is that all three operators make positive profits, with the franchisee performing the best, as shown in Table 14.

TABLE 14 DIFFERENTIATED 3 OPERATOR OUTCOMES

	Franchisee	Open Access 1	Open Access 2	Industry
Northbound services	13	11	10	34
Southbound services	13	11	10	34
Revenue	£47.4m	£12.9m	£13.1m	£73.4m
Costs	£27.2m	£7.5m	£7.3m	£42.0m
Profit	£20.2m	£5.4m	£5.8m	£31.4m
Consumer Surplus				£88.7m
Welfare				£120.1m

We can see that the resultant user benefits (consumer surplus) is lower in this case by some 32%. The reason for this is that the franchisee, unchallenged on its first class fare, sets it far higher than in the previous case (by 256%) and sets its standard class fares higher than the other two operators to capture any residual standard class travel. The franchisee competes more by using its saver fare to attract standard class travel. The two open access operators obviously only offer full standard class travel (club class) and compete on this fare between themselves. As a result of these factors, user benefits fall below the other three operator case. Welfare shows a similar pattern in spite of the positive industry profits. Indeed, from a welfare standpoint, the differentiated three-operator case is much more inferior than all the other duopoly outcomes. In Table 15 we present the average single fares for each operator.

TABLE 15 : DIFFERENTIATED THREE OPERATOR FARES

	Franchisee	Open Access 1	Open Access 2
First Class	£45.48		
Standard Class	£18.91	£12.97	£11.68
Saver Class	£10.39		

We can see that without product differentiation an additional open access operator brings about a much greater reduction in industry profits. If the Regulator wishes to increase competition, increase user benefits but also maintain industry profits then it must insist that operators differentiate their products. However, if the Franchise Director wishes to maximise use benefits then it must increase the level of subsidy to the industry. It is interesting to note that both three-operator cases are welfare-inferior, but for different reasons : the first case because negative industry profits prevail in equilibrium, and the second case because the franchisee faces no direct competition on two of its fares

4.4 Track Access Charges and ROSCOs

In this section we will examine what market outcomes will evolve when the franchisee pays a lump sum access charge to Railtrack, and also leases its rolling stock from a hypothetical ROSCO. In addition to the rolling stock lease the operators still have to cover their marginal operating costs (fuel, crew, stabling and cleaning and catering).

We will also assess the implications of entry by a single open access operator who also leases its rolling stock but does not pay the access charge. Both operators in this instance will use IC225 rolling stock and pay their avoidable costs.

The flat access charge imposed upon the franchisee, and the ROSCO leasing charge has led to an increase in the number of services operated compared to the regulated duopoly case. The reason for this is that the train operators do not incur any marginal infrastructure costs, because of the flat rate access charge, and so do not pay more for operating more services. As a result of this and the large decreases in average single fares, as shown in Table 17, user benefits are high. As for welfare the correct measurement must include the actual profit/loss incurred by Railtrack. The access charge was calculated in advance of how many services were operated and actual infrastructure costs may be more than the revenue received from the charge. Indeed, we can see that this is the case, with Railtrack suffering losses in both the monopoly and duopoly scenarios.

The main consequence of this is that the access charge will have to be increased, or the open access operator forced to pay a charge also.

The total welfare generated excluding Railtrack, denoted Welfare (I), is higher than in any of the other scenarios. However, when the negative profits of Railtrack are included we find that total welfare falls narrowly below the welfare generated with an unregulated duopoly. One further point to note is that the resultant profits and welfare values are also dependent on the lease price on rolling stock.

TABLE 16 ACCESS CHARGES AND LEASING OUTCOMES

	Monopoly	Franchisee	Open Access 1	Industry
Northbound services	14	14	15	29
Southbound services	14	15	15	30
Revenue	£77.9m	£37.6m	£25.2m	£62.8m
Costs	£28.9m	£29.7m	£18.5m	£48.2m
Profit	£49.0m	£7.9m	£6.7m	£14.6m
Consumer Surplus	£70.4m			£128.6m
Welfare (I)	£119.4m			£143.2m
Railtrack Profit	(£1.2m)			(£6.7m)
Welfare (II)	£118.2m			£136.5m

The profits of the individual operators, while positive, are lower than in comparative duopoly cases. Thus, while we can say that such proposals are likely to lead to more services operated, it is at the cost of lower industry profits.

TABLE 17 ACCESS CHARGE SCENARIO FARES

	Monopoly	Franchisee	Open Access
First Class	£49.16	£14.95	£14.46
Standard Class	£25.39	£7.26	£7.06
Saver Class	£12.35	£4.38	£4.31

Compared to the duopoly outcome with minimum hourly service requirements, we can see that fares are lower here in every fare class. The franchisee's first class, standard class and saver class fares are 29%, 20% and 24% lower on average, while the open access operator's fares are 30%, 10% and 19% lower, respectively. However, in the monopoly case they were very close to the regulated monopoly.

5 CONCLUSIONS

We have shown that there is definitely scope for competition in the industry and that competition can lead to improvements in allocative efficiency. However, beyond the two operator case it is not always sustainable without extra support, unless product differentiation is insisted upon. Too much competition may indeed be harmful to the industry and result in lower industry profits. Therefore, if competition is to be encouraged the extent and nature of it must be carefully considered.

In general, we find that industry profits are higher under monopoly franchises. The exception to this finding is when open access operators enter the market offering a differentiated product, which in our case was "club class" travel using Class 321 rolling stock. Here, industry profits lie roughly midway between monopoly profits and the normal duopoly/three operator profits. An interesting outcome from the analysis is the three operator case where negative industry profits are experienced. This would tend to suggest that entry by more than one operator is unsustainable unless some degree of differentiation occurs.

Users, on the other hand, benefit most under the three operator scenario where consumer surplus is highest (£131.3m). As expected, consumer surplus is lowest under the unregulated monopoly scenario (£69.7m) resulting from high fares and a reduced service pattern. Indeed, in all cases where competition exists, consumer surplus is higher than under monopoly conditions, implying that competition can benefit users. Competition will also force franchisees to become more focused about their business and market conditions, which should ultimately lead to efficiency gains in the future.

Sufficient capacity may not exist on major routes to permit access at a profitable level. Much of the network already operates under considerable capacity constraints, including the GNER network. Therefore, our findings concerning the benefits of some degree of competition must be tempered with some degree of caution. In addition, it is unlikely that open access operators will be in a position to bid for trainpaths simply because of the complexity of organising trainpaths. Thus, the Franchise Director will continue to have a major say in determining service patterns and trainpath packages. Given that tight regulation of the timetable can lead to problems for the franchisee when access is permitted there is an obvious trade-off between competitive forces and franchisee freedom.

With regard to welfare, we can see that an unregulated duopoly and a regulated duopoly (minimum of one service an hour) deliver the highest total welfare. A duopoly situation with a flat rate access charge and rolling stock leasing delivers a high level of welfare also. Thus, if the Rail Regulator is concerned with maximising total welfare then it should consider allowing entry by a single open access operator to compete with the franchisee. However, we noted that the welfare implications under the current structure depend in part on the ROSCO's leasing charges.

The main long term aim of the Franchise Director must be to make franchises as attractive as possible for future sale, and this may mean limiting open access competition, even though it can lead to large welfare gains. However, in the longer term a certain amount of competition should be actively encouraged by the Rail Regulator.

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