

NATIONAL EXPRESS GROUP/THAMESLINK GREAT NORTHERN RAIL INQUIRY

REVIEW OF RAIL AND COACH ELASTICITIES

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October 2005

1. OBJECTIVES

The aim of this review is to provide the Competition Commission with recommended own and relevant cross elasticities for its investigation into the possible acquisition of the Thameslink Great Northern rail franchise by National Express Group. This will be based on a review of industry standard recommendations, as contained in the Passenger Demand Forecasting Handbook (PDFH), and a review of other literature to determine the extent to which it would be sensible to recommend different elasticities for some or all flows on this franchise.

Of interest to this investigation are:

- a) own-price and generalised journey time (GJT) elasticities of demand for rail services;
- b) cross-price and frequency elasticities of demand for rail services with respect to other modes;
- c) operator specific own price and GJT elasticities of demand for certain overlap flows;
- d) operator-specific (coach and rail) cross-price and GJT elasticities of demand with other modes of transport for certain overlap flows.

At the outset, it is important to make some important general points relating to the empirical evidence relevant to this review:

- Where elasticities are disaggregated, it is usually by ticket type since most analysis is conducted on ticket sale data. Of course, season tickets represent commuting trips, but other tickets contain a mixture of mainly business and leisure travel and some commuting.
- There is more evidence available on fares than GJT.
- There is relatively little evidence relating to coach travel
- There is less empirical evidence relating to cross than own elasticities and the former are regarded to be inherently more variable and less transferable than the latter.
- Most evidence is available at the regional rather than route level. The former Network South East sector of British Railways and the PDFH tend to make few distinctions by route. Whilst the privatisation of the rail industry has provided a major stimulus to train operating companies to conduct analysis to determine elasticities more appropriate to their routes and conditions, few findings have emerged even within the wider rail industry. The coach industry

generally conducts less research and is notorious for keeping its findings to itself.

- Fare competition between operators cannot be examined using cross elasticity evidence where the fares are inter-available.

The structure of this report is as follows. Section 2 provides a review of industry standard recommendations contained in PDFH. These cover fare and generalised journey time (GJT) elasticities and touch upon generalised cost (GC) elasticities. Section 3 reviews evidence which is specific to the Thameslink Great Northern franchise. Evidence relating to coach own elasticities are covered in section 4 whilst section 5 covers the impact of changes in the fare and service quality of coach on rail demand. A limited consideration of the impact of rail on coach demand is given in section 6. Recommendations are contained in section 7.

2. REVIEW OF PDFH RECOMMENDATIONS

The Passenger Demand Forecasting Handbook (PDFH) contains the recommended forecasting framework and demand parameters that are widely used in the rail industry in Great Britain.

PDFH does not specify own demand elasticities unique to train operating companies let alone flows, although it does contain a procedure whereby cross elasticities between tickets can be deduced that are route specific. Instead, the own elasticities recommended by PDFH disaggregate only by former British Rail sector, of which Network SouthEast is here relevant, with some allowance by distance and different values according to journey purpose.

2.1 PDFH Fare Elasticities

The most recent version of PDFH (ATOC, 2005) made major revisions to the recommended fare elasticities. In part this was to account for journey purpose variations but the opportunity was also taken to specify the elasticities as explicitly long run terms¹. The revised elasticities were based on a review of a large amount of empirical evidence and the rationale for the amendments is clearly set out in supporting documentation. The procedure also ensured, at an aggregate level, that the elasticities recommended by journey purpose were consistent with those recommended by ticket type according to the proportions of different journey purposes for each ticket type.

The own fare elasticities recommended by PDFH relevant to the routes of interest here are set out in Table 1.

¹ The long run is when the full effect of a change in, say, fare has worked through the system. It takes time for information to diffuse and for behavioural constraints to be overcome. There is some uncertainty, however, as to how long the long run is. PDFH contends that most of the effect has worked through within a year. Long run elasticities are somewhat larger than short run or instantaneous elasticities which tend to relate to the four weekly accounting period used by the railway industry.

Table 1: PDFH Recommended Fare Elasticities

	Seasons	Other	Commute	Business	Leisure
London Travelcard Area	-0.60	-0.85	-0.60	-0.55	-1.05
London Travelcard Area & SE	-0.60	-1.10	-0.60	-0.80	-1.45

For the Gatwick to London flow and also flows to and from Gatwick of less than 30 miles, the recommended fare elasticity is -1.1. For Gatwick flows over 30 miles, the recommended fare elasticity is -0.90.

The PDFH also provides a means of amending the fare elasticities according to the fare charged per mile. The modifier is itself in terms of an elasticity of 0.6, which indicates that a 10% increase in the fare per mile above the average would lead to a 6% increase in the fare elasticity. Whilst such a recommendation is in some respects commendable, since we would expect fare elasticities to be higher where fares were higher or 'value for money' was less, the evidence base for applying such a modifier to flows in the South East is not strong since it relates to flows outside of the South East.

2.2 PDFH GJT Elasticities

What is termed generalised journey time (GJT) in the railway industry takes a very specific and different meaning to the generalised time (GT) that is widely used in transport planning. It takes the form:

$$GJT = T + aH + bI$$

The GJT between two stations is composed of the station-to-station journey time (T), the headway in minutes between departures (H) and the number of interchanges (I). The parameters a and b are termed headway and interchange penalties and convert the inconvenience of the headway between departures and any need to interchange into equivalent amounts of journey time.

Previous versions of PDFH allowed the GJT elasticities to vary with the quality of rail service and the strength of competition from other modes. This was dropped since it was based on only a single study and then one that related only to inter-urban flows on Non London routes. Application of the recommendations also required a considerable amount of judgement.

The most recent edition of PDFH (ATOC, 2005) made some significant revisions to GJT based on a large scale review of empirical evidence. The recommended elasticities for the TOC's of interest here are reported in Table 2 for season tickets and all other tickets. There is no strong evidence to suggest that GJT elasticities vary according to journey purpose other than the distinction between commuting (seasons) and other purposes (Other).

Table 2: PDFH Recommended GJT Elasticities

	Seasons	Other
London Travelcard Area	-0.7	-0.8
South East to London TCA	-0.7	-0.8
London TCA to South East	-0.8	-0.9
South East Non London	-0.9	-1.0

Note: Much of the growth in commuting will arise from redistribution of existing rail passengers between routes, and it should be assumed that 30% of the forecast growth in peak traffic is abstracted from other rail services in the South East (not necessarily from adjacent routes).

For airport flows, PDFH recommends a GJT elasticity of -1.5 for outbound traffic and -1.0 for inbound traffic.

2.3 PDFH GC Elasticities

There is little evidence on generalised cost (GC) elasticities for rail travel. This is because the forecasting framework used by the rail industry in Great Britain treats fare and GJT separately and thus GC elasticities are of no direct use. Where disaggregate choice models are estimated, such as in the context of forecasting mode choice, these invariably specify separate terms not only to fare but also to the separate terms of GJT. The GC between two stations is defined as:

$$GC = F + \nu GJT$$

where F is the fare between the two stations and ν is the value of time which allows GJT to be converted into an equivalent amount of money. Demand (Q) is usually related to GC in constant elasticity form:

$$Q = GC^\beta$$

where β is the GC elasticity. The implied GJT and fare elasticities can be derived as:

$$\eta_{GJT} = \beta \frac{\nu GJT}{GC}$$

$$\eta_F = \beta \frac{F}{GC}$$

It follows therefore that although the rail industry has little evidence relating to the GC elasticity, it can be estimated if so desired as the sum of the fare and GJT elasticities about which much is known.

3. REVIEW OF RAIL ELASTICITY EVIDENCE SPECIFIC TO THE TGN FRANCHISE

PDFH permits a limited amount of elasticity variation according to broad categories of distance from London and type of flow.

We here consider the empirical evidence that relates specifically to the TOCs and routes of interest here to determine whether there is any basis for differentiating the TGN elasticities and those of certain flows from those recommended for the South East in PDFH. Route specific variations in elasticities might come about as a result of variations in rail fares and service quality, the precise journey purpose mix, local socio-economic features and also in the degree of competition from other modes, particularly the congestion charge which will not only have increased rail demand but may have reduced the rail elasticities.

3.1 Fare Elasticities

Steer Davies Gleave (1993) reviewed the empirical evidence relating to fare elasticities in the South East and also conducted a major stated preference study to produce a set of fare elasticities split by market segment and journey distance which formed the basis of PDFH recommendations.

Although somewhat dated now, the study provided some interesting findings. Route specific elasticities were estimated and of relevance to this study are those estimated for Great Northern Inner services.

For commuting and business, the fare elasticity was estimated at -0.16. This contrasted with overall figures of -0.34 and -0.24 for season tickets as a whole for trips up to 15 miles and between 16 and 60 miles. The respective figures for Non London seasons were -0.55 and -0.32 respectively. The argument advanced for the lower figures for the Great Northern Inner services was that a relatively good service was provided which provided good access to the City with weak competition from other modes.

The elasticity estimated for Great Northern Inner services leisure trips was -0.76. For leisure trips with and without a railcard, the fare elasticities across all flows in the South East were -0.61 and -0.78 for trips up to 15 miles, and -0.59 and -0.73 for trips between 16 and 60 miles. In this market, the Great Northern Inner services' fare elasticity appears little different to the average across the region.

Overall, Steer Davies Gleave (1993) concluded from their SP analysis that there was no convincing evidence to support a general relationship in the South East between the fare elasticity and either the quality of rail service or the strength of the competition, although differences. The fare elasticity for commuters not travelling to London was significantly higher than the elasticity for London commuters and in both cases the elasticity was lower for longer distance trips. However in all the other market segments the elasticity did not depend on whether London was the destination whilst in the leisure market there was a tendency for the elasticity to increase with distance.

Wardman (1993) conducted analysis of ticket sales data with the explicit aim of testing whether rail fare and GJT elasticities varied with the competitive position. The latter was specified as both the relative generalised cost of rail and car and the relative generalised cost of rail and coach. Whilst significant effects on both the rail fare and

GJT elasticities from both car and coach competition were discerned for inter-urban Non London routes, no such effects could be detected for flows in the South East.

To follow this study up, since the number of flows in the South East was not particularly large and GJT and fare did not exhibit large variations over time, a stated preference (SP) study was conducted on a large number of flows in the South East. It examined competition from both car and coach on rail demand and elasticities (Wardman and Whelan, 1995).

No effect from car competition was apparent in the commuting model but the rail GJT and fare elasticities did vary with the relative GC of rail and bus (Π_{RB}). The fare elasticity was estimated as:

$$\eta_F = -1.688\Pi_{RB}^{0.6}$$

The power term implies a sensible amount of variation in the fare elasticity. However, the absolute level of the fare elasticity is high for commuting trips such that little credence can be placed on these results. The median fare elasticity was -1.56, with 10th and 90th percentiles of -1.41 and -1.77.

An analysis of ticket sales data for the years 1987/88 through to 1993/94 was carried out by TCI-OR to explore fare elasticities in the South East (ATOC, 2005; chapter C2). The analysis included flows between all stations in the South East and Central London. The elasticity estimates and associated confidence limits are shown in Table 4. There is no evidence to support the fare elasticity increasing with distance for full and reduced tickets. The evidence for the season ticket must be treated with caution given that the estimate for the short distance flows was not statistically significant. It is for these flows that ticket sales based evidence is least strong due to the strong interactions with travelcards which is difficult to account for.

Table 4: South East Fare Elasticities by Distance

Flow (Distance)	Season tickets	Full & Reduced	All tickets
Short (< 15 miles)	-0.1 (± 0.2)	-0.6 (± 0.2)	-0.1 (± 0.2)
Medium (15-60 miles)	-0.5 (± 0.1)	-0.7 (± 0.2)	-0.6 (± 0.2)
Long (> 60 miles)	-0.5 (± 0.2)	-0.5 (± 0.2)	-0.9 (± 0.2)

The study also found significantly different fare elasticities for different geographical groups of stations, although significant results could not be produced for individual stations. The variations in elasticities could not be very satisfactorily explained by differences in passenger or station group characteristics other than distance from London, although there was a suggestion that the wealthier passengers displayed greater elasticity².

CEBR (1998) analysed the demand for rail travel to London on five corridors. Models were estimated to CAPRI data for season tickets, standard and first class tickets, and reduced fare tickets, for the period 1987-1996.

A large number of economic variables were tested, including fare variables. The fare elasticities estimated for each route and ticket type are reported in Table 5.

² More precise details about these geographically grouped elasticities is not available

Table 5: Fare Elasticity Estimates by Ticket Type for South East Areas

	All	South	South West	North West	North	North East
Seasons	-1.4	-2.1	-1.9	-1.5	-1.3	-1.6
Full	1.2	1.0	1.3	0.4	1.0	0.6
Reduced	-0.9	-	-1.2	-0.9	-1.1	-1.1

The season ticket elasticities are generally much higher than estimates obtained for commuting flows in the South East or indeed elsewhere. They could be reflecting the loss of traffic to other tickets whilst collinearity between the fare and other variables is a possibility.

The full fare elasticity is estimated to a variable that is the relative price of motoring with respect to rail and hence this elasticity should be, and in fact is, positive. The problem with this specification is that it constrains the own elasticity of rail demand with respect to rail fare to be the same size but opposite sign to the cross elasticity of rail demand with respect to car cost. This functional form presumably stemmed from an attempt to overcome multicollinearity problems but it is not reasonable.

The reduced fare elasticities lie in a narrow range, excepting the statistically insignificant effect for the South flows. These elasticities seem plausible, although there are doubts as to whether they are long run effects, and they do not point to the fare elasticities for the North routes of interest being any different to the other routes in the South East.

NERA (1999) estimated dynamic models to four weekly ticket sales data covering the years 1990 to 1997. Separate models were estimate for a wide range of routes. Of interest here are the results for TGN flows. Models were estimated for Gatwick, St Albans and Hatfield to London and the elasticities for each flow are reported in Table 6 along with the average across all flows.

Table 6: NERA Flow Specific Elasticities

Flow	Short Run	Long Run
Gatwick-London	-0.843	-1.100
St Albans-London	-1.078	-1.425
Hatfield-London	-0.916	-1.017
All (16)	-0.851	-1.119

Note: For shorter distance movements, long run elasticities for East Croydon and Norbury to London of -1.243 and -1.789 were estimated. Whilst these flows are served by Thameslink services, these are not the primary services on these routes.

The Gatwick elasticity is higher than might be expected on a flow which is dominated by relatively high income travellers typically making international journeys for business or holidays. We might speculate that offsetting this is the relatively strong degree of competition from other modes, including various forms of public transport access and an above average level of lift giving. The PDFH recommended elasticity

is the same as the elasticity estimated here but this is hardly surprising since it is one of the few pieces of information available for airport flows.

The elasticities cover both season and non-season tickets. On many routes, these have a fairly even share of trips. In the absence of information to the contrary, the elasticities here are higher than would be expected on the basis of PDFH recommendations of -0.6 for season tickets and -1.1 for non-season tickets.

Steer Davies Gleave (1999) conducted research as part of the study that developed the Rail Industry Forecasting Framework (RIFF). Although the focus of the study was on the effects of economic activity and competition on rail demand, fare elasticities were also tested. The results are contained in Table 7.

Table 7: South East Fare Elasticities Estimated for RIFF

Flow Type	Seasons	Full	Discounted
< 35 miles	-0.12 to -0.32	-0.38	-0.96
35-85 miles		-0.29	-1.03

The season ticket elasticity varied between -0.12 and -0.32 , although these are not long run effects. It was concluded that, “there may also be longer term fare effects on Seasons due to the lag in renewal of annual seasons, and longer term population distribution and employment market effects”.

The full fare elasticities up to 85 miles seem sensible given the market conditions and the elasticities for discounted tickets are very reasonable. There does not appear to be any strong evidence to support a distance effect within the South East.

In previous reports for the Competition Commission, we have provided more localised fare elasticities by making use of the extensive meta-analysis we have conducted (Wardman and Shires, 2004). In particular, this took the form of different elasticities by distance band.

However, the distance elasticity in the meta-analysis relates only to non-commuting trips and thus it is only possible to provide separate elasticities for business and leisure trips in the South East. These are provided in Table 8. Given that the distance elasticity is only 0.09 and only operates above 30 miles, and that the range of distance in this context is small, the variation in fare elasticities implied by the meta-model is minor.

Table 8: Elasticities by Distance Implied by Meta Model

	Business	Leisure
Up to 30 miles	-0.57	-1.05
40 miles	-0.78	-1.44
50 miles	-0.80	-1.47
60 miles	-0.81	-1.49
70 miles	-0.82	-1.51

3.2 GJT Elasticities

OR (1989) examined the impact of Great Northern electrification (1976-78) and the Midland Suburban electrification (1983). The study focussed on stations outside of Great London and abstraction from neighbouring routes was accounted for. Account was also taken of the impacts of new rolling stock using then PDFH recommendations.

The estimated GJT elasticities were -0.8 and -1.3 for inner and outer Great Northern services and -1.0 for Midland Suburban services. These results indicate a distance effect which is not apparent in PDFH recommendations. However, the evidence is dated and there are concerns surrounding the estimation (control flow) technique used which is not a standard procedure but essentially involved comparison of demand changes on the affected routes with demand changes on comparable routes which have not experienced the service quality change of interest.

The Wardman (1993) study cited in section 2.1 found no effect from the competitive position of rail and other modes on rail GJT elasticities in the south East. The Wardman and Whelan (1995) SP study found the GJT elasticity for commuters to vary with the relative GC of rail and bus (Π_{RB}). It took the form:

$$\eta_{GJT} = -1.383\Pi_{RB}^{2.0}$$

The median GJT elasticity was -1.05, with 10th and 90th percentiles of -0.77 and -1.61. Whilst the central GJT elasticity estimate is plausible, the power term implies very strong variation in the rail GJT elasticity simply due to coach competition. We do not find this entirely reasonable, particularly since no effect could be detected from the relative GC of rail and its main competitor car.

Steer Davies Gleave (1999) conducted research as part of the study that developed the Rail Industry Forecasting Framework (RIFF). The GJT elasticity estimated for a variety of routes in the South East were:

- Seasons -0.33
- Full < 35 miles -0.46
- Full 35-85 miles -0.18
- Full 85-150 miles -0.40
- Discounted < 35 miles -0.78
- Discounted 35-85 miles -0.61
- Discounted 85-150 miles -0.70

There is some evidence for lower GJT elasticities for full fare. Whilst this seems odd, since we might expect these travellers to be more sensitive to service quality changes, countering this is the high share that rail will have in the market in which full fare tickets compete. There is no support for a distance effect. It should be borne in mind that service quality variations on these routes would have generally been minor.

3.3 Evidence for TGN Specific Elasticities

Although there is more than a trivial amount of elasticity evidence relating specifically to the South East and issues such as distance and competition, with less empirical evidence relating specifically to flows on the TGN franchise, we do not feel that there

is compelling evidence to depart from PDFH recommendations for the rail own elasticities to be used for these flows.

4. COACH OWN ELASTICITIES

Evidence on coach elasticities of demand is sparse. The evidence summarised in Table 9 below is drawn from our 1996 report to the MMC (MMC, 1996) in its investigation into the Midland Main Line Merger.

Table 9: Coach Own Elasticities

Study	Context	Fare	Time	Head
1: Douglas (1987)	Inter Urban Coach Flows	-1.10		
2: HFA (1990)	SP on Inter Urban Travel	-1.20	-1.30	
3: Oscar Faber TPA (1993)	Cross Forth journeys. 9% business, 67% commuting	-0.45	-2.10	-0.73
4: Toner and Wardman (1993)	Leisure travel in South East	-0.37	-1.00	-0.50
5: TPA (1992)	TransPennine trips for leisure purposes	-0.21	-0.13	

Note: The elasticities in studies 3, 4 and 5 take no account of trip generation and hence would be too low.

4.1 Coach Fare Elasticities

Much of the evidence here relates to inter-urban journeys. The most relevant evidence is that of Toner and Wardman (1993) which relates to the South East and to the leisure market where the interactions between rail and coach are expected to be greatest. However, allowance must be made for the generation/suppression of trips as fare changes, over and above the demand changes caused by mode switching, and these might be relatively large in the coach leisure market. Moreover, we find it difficult to believe that the coach leisure market is inelastic with respect to fare, particularly when there is evidence pointing to an off-peak fare elasticity greater than -1 for rail. Douglas (1987) obtained a very plausible fare elasticity for inter-urban coach travel of -1.1. We do not consider the estimates obtained by HFA (1990) on the basis of their econometric analysis of the volume of coach travel to be reliable and therefore we have not used them. However, HFA (1990) do provide elasticities to time and fare based on an alternative approach using Stated Preference data. The remaining elasticities in Table 9 should be regarded as lower bounds since they do not account for the generation of new trips.

In our previous advice to competition commission, we have opted for a coach fare elasticity of -1.1 seems reasonable. Whilst this is lower than the leisure fare elasticity in the rail market, this could be accounted for by coach fares being generally lower than rail fares and coach travellers having fewer alternative modes of travel.

This coach fare elasticity also compares favourably with the figure slightly above unity for the bus fare elasticity in the long run that was uncovered by the large scale review of fares conducted as part of updating the 'Black Book' demand for public transport (TRL et al., 2004)

4.2 Coach Journey Time Elasticities

The journey time elasticity for the only study that relates to the South East is large, particularly when the absence of generation effects is borne in mind. We can use the 'ratio of elasticities' approach to deduce elasticities from reference elasticities. The relationship between the journey time elasticity (η_T) and the fare elasticity (η_F) is:

$$\eta_T = \lambda \frac{T}{F} \eta_F$$

where T and F are the levels of journey time and fare and λ is the value of time.

However, in this inquiry the issue of changes in coach journey times is not being investigated and instead it is the headway elasticity which is more important.

4.3 Coach Headway Elasticities

The headway elasticities reported in Table 9 at first sight appear to be too large, particularly bearing in mind that the effect of newly generated trips needs to be added. However, headway elasticities for coach may be relatively large where the frequency of services tends to be poor.

The headway elasticity can be deduced from the fare elasticity as:

$$\eta_H = \beta \frac{H}{F} \eta_F$$

where H is the headway, F is the fare level and β is the value of headway.

The Wardman (2005) meta-analysis would imply current headway values of around 3.26 pence per minute for coach. This is subsequently used along with a fare elasticity and the levels of fare and headway to deduce headway elasticities for flows of interest.

5. RAIL-COACH CROSS ELASTICITY EVIDENCE

The main interest here is the impact of changes in the fare and service quality of coach on the demand for rail travel.

There have been two main streams of analysis of travel demand which have a degree of complementarity. Econometric direct demand models are based on aggregate volumes of demand and are invariably mode specific. On the other hand, disaggregate choice models examine the decisions made by individuals or groups of travellers and have been widely applied to the analysis of mode choice. Almost all of the evidence above relating to own elasticities is taken from direct demand models relating to variations in aggregate rail movements. These models are well suited to such analysis, particularly since they automatically include changes in trip frequency that result from changes in fares and service characteristics which are absent from disaggregate mode choice models. However, these aggregate models often fail to specify terms relating to competing modes or else struggle to obtain sensible cross elasticity estimates. In contrast, the very nature of disaggregate mode choice models

means that cross elasticity estimates are readily output, and the evidence considered here is largely derived from such models.

5.1 Evidence of Coach Impacts on Rail

As far as we are aware, the only study which has directly estimated the impact of coach on rail demand within a direct demand model is that reported in Wardman (1993). The results of this study were cited in the Monopolies and Mergers Commission's Midland Main Line enquiry (MMC, 1996).

The directly estimated cross elasticities of rail demand with respect to coach were 0.14 for fare, 0.09 for journey time and 0.05 for headway³. However, these figures relate to inter-urban travel on Non London routes and might not be relevant here.

We are aware of two studies which have reported cross elasticities between rail and coach/bus in the South East.

Using SP data and a method of analysis similar to that used to analyse ticket sales data, Wardman and Whelan (1995) obtained cross elasticities of rail demand with respect to coach fare, time and headway of 0.10, 0.50 and 0.08 for commuting. The equivalent figures for leisure travel were 0.23, 0.48 and 0.18. The higher cross elasticities for leisure travel could be because coach's share relative to rail is higher in the leisure than commuting market.

Using RP data and the more conventional approach of a hierarchical logit model, Toner and Wardman (1993) obtained cross elasticities in the South East leisure market of 0.05 for cost, 0.14 for time and 0.03 for headway.

The most recent review of cross elasticities insofar as they relate to rail travel that we are aware of was undertaken by Steer Davies Gleave (1999). The figures recommended in that study are those which are recommended in the PDFH.

Table 10 lists PDFH's recommended cross elasticities of rail demand with respect to coach characteristics. The figures split by journey purpose are those recommended by the Steer Davies Gleave (1999) review. PDFH converted them into ticket type elasticities using information on the proportion of each journey purpose by ticket type.

³ Although cross elasticities with respect to coach travel could be specified in GJT, they are typically expressed in units of the separate components of GJT.

Table 10: PDFH Recommended Cross Elasticities

	Fare	Time	Head
London Travelcard Area			
Commuting	0.10	0.05	0.025
Business	0.00	0.00	0.000
Leisure	0.20	0.05	0.025
South East to London			
Seasons	0.00	0.00	0.00
Other	0.17	0.17	0.03
Commuting	0.00	0.00	0.00
Business	0.00	0.00	0.00
Leisure	0.30	0.30	0.05
Other South East			
Seasons	0.20	0.20	0.05
Other	0.20	0.20	0.03
Commuting	0.20	0.20	0.05
Business	0.00	0.00	0.00
Leisure	0.30	0.30	0.05
Airports			
Business	0.00	0.00	0.00
Leisure	0.20	0.20	0.05

Source: Table B1.7 PDFH.

5.2 Deducing Cross Elasticities

The main problem with the above review and attempts to identify what is implicitly the most appropriate single set of cross elasticity estimates is that cross elasticities can be expected to vary much more than own elasticities and to be strongly influenced by market share. Such variations are apparent in the above review evidence and will be demonstrated below for different flows of interest in this inquiry.

Whilst econometric demand models struggle to uncover variations in own elasticities when explicitly tested for, we expect cross elasticities to be very much more variable, and indeed the cross-elasticities in discrete choice models vary with market shares. The relationship between own and cross elasticities for any particular variable can be expressed as:

$$\eta_{ij} \leq \left| \eta_{jj} \right| \frac{S_j}{S_i}$$

where η_{ij} is the cross elasticity, η_{jj} is the own elasticity and S_j and S_i are the shares of modes j and i .

If we have information on 'diversion factors', we can obtain an estimate of the cross-elasticity, rather than an upper bound, as follows:

$$\eta_{ij} = \left| \eta_{jj} \right| \frac{S_j}{S_i} \delta_{ji}$$

where δ_{ji} is the proportion of those diverting from mode j who switch to mode i .

To deduce cross elasticities of rail demand, we require diversion factors from coach to rail. The diversion factors between coach and rail were estimated at around 60% by Vicario (1999), 40% by Robbins and White (1985) and 30% by Bleasdale (1983). In the NEG/Greater Anglia inquiry, the diversion factor obtained from the survey of coach leisure travellers on the Colchester to London route was 22%, increasing to 50% on the Ipswich to London route.

We have here assumed a figure of 50% of coach travellers would switch to rail. Where there is more than one rail operator, it is assumed that this switch to rail will split between the rail operators according to their existing shares. As a consequence of this assumption, the cross elasticity of demand for rail operator 1 with respect to coach is the same as the cross elasticity of demand for rail operator 2 with respect to coach which is the same as the cross elasticity of overall rail demand with respect to coach.

Table 12 lists the ratio of coach and rail demand in the leisure market on key flows derived from volume data supplied by the Competition Commission. Coach demand is assumed to be entirely leisure travel. Following PDFH recommendations, the proportion of rail travellers on daily (non-season) tickets travelling for leisure purposes is taken to be 55%.

Table 12: Market Shares in the Leisure Market

Flow	Coach/Rail
Brighton-London	0.157
Brighton-Gatwick	0.474
Gatwick-London	0.042
Gatwick-Luton Airport	0.210
Gatwick-Luton	0.167
Luton-Luton Airport	0.004
Cambridge-London	0.135

Deducing the cross elasticities also requires values for the coach own fare elasticity and the coach own headway elasticity. The former is taken to be -1.1, as discussed in section 4.1. Section 4.3 recommended that the latter is deduced using the ratio of elasticities approach and recommends a values of headway of 3.26 pence per minute along with the fare elasticity of -1.1 and current levels of fare and headway supplied by the Competition Commission. These yield the headway elasticities (η_H) across routes depicted in Table 13.

The expected variation in cross elasticities across routes can be observed in Table 13. The cross elasticity relating to, for example, the Brighton-Gatwick flow is relatively high because the coach service is relatively good and achieves a high share. Note, however, that few of the flows achieve the cross elasticities recommended by PDFH and set out in Table 10 above.

On many other routes, there is effectively no competition from coach and the cross elasticities would be trivial. For example, the relative share of coach and rail between Huntingdon and London would be less than 0.005. Such a figure would imply a cross elasticity between rail demand and coach fare of 0.003! The same argument applies

to rail and coach competition on the flows on the route between Cambridge and Hitchin.

Table 13: Deduced Leisure Cross Elasticities

	Fare	η_H	Headway
Brighton-London	0.087	-0.44	0.035
Brighton-Gatwick	0.260	-0.20	0.047
Gatwick-London	0.023	-0.52	0.011
Gatwick-Luton Airport	0.116	-0.34	0.036
Gatwick-Luton	0.092	-0.26	0.022
Luton-Luton Airport	0.002	-2.15	0.043
Cambridge-London	0.074	-0.44	0.030

Notes: Different diversion factors will lead to different cross elasticities in the same proportion. Thus a 10% increase in the diversion factor will lead to a 10% increase in the relevant cross elasticity.

6. IMPACT OF RAIL ON COACH DEMAND

The Competition Commission were also interested in the cross elasticity of coach demand with respect to rail fare and headway on the Brighton to London flow.

This issue is again addressed using the diversion factor relationship set out in section 5.2. Given a rail fare elasticity of -1.45 recommended by PDFH for leisure travel, a ratio of rail and coach volume of 6.369 and a diversion factor of 23% as contained in Vicario (1999), the cross elasticity of coach demand with respect to rail fare is estimated to be 2.12.

For the headway cross elasticity, we need the rail headway elasticity. Given a recommended GJT elasticity of -0.8 on this route, and the headway forms 20% of GJT, the headway elasticity is -0.16. This yields a headway cross elasticity of 0.23.

7. RECOMMENDATIONS

The key recommendations from this review as far as this investigation is concerned are set out below.

The evidence does not support TGN specific rail fare elasticities. We therefore recommend that PDFH values are used. The rail own elasticities for fare are -0.80 in the business market, -0.60 in the commuting market and -1.45 in the leisure market. For airport users' trips between London and Gatwick the fare elasticity is -1.1 across all market segments.

The recommended GJT elasticities are also those of PDFH. For season tickets, these are -0.7 for trips to London, -0.8 for trips from London and -0.9 for Non London trips. For trips entirely within the London Travelcard area the GJT elasticity is -0.7. For non-season tickets, no distinction is made between leisure and business travel. The GJT elasticities for trips to, from and Non London are -0.8, -0.9 and -1.0 respectively. Trips entirely within the Travelcard area are assigned a value of -0.8.

As far as cross elasticities between rail and coach are concerned, our preference is to deduce specific elasticities according to relevant market conditions. Estimates for relevant flows were set out in Table 13. These were based on the relative demand of rail and coach and the following key parameters:

- 50% of coach users switch to rail
- Coach own price elasticity of -1.1
- Coach headway elasticity deduced from the fare elasticity using a value of headway of 3.26 pence per minute, the fare elasticity and the current levels of coach fare and headway.

The cross elasticities of coach demand with respect to rail make use of the rail elasticities cited above and 23% of rail users switching to rail.

References

ATOC (2005) Passenger Demand Forecasting Handbook. Version 4.1.

Bleasdale, C. (1983) The Effect of Deregulation on InterCity Rail Services. PTRC Summer Annual Meeting.

Centre for Economic and Business Research (CEBR, 1998) Rail Forecasts for the West End and City. Prepared for the Passenger Demand Forecasting Subscription Service

Douglas, N.J. (1987) A Welfare Analysis of Transport Deregulation. Gower Press.

HFA (1990) Market Research Study into Coach Demand. Prepared for London Regional Transport.

Monopolies and Mergers Commission (1996) National Express Group PLC and Midland Main Line Limited: A Report on the Merger Situation. Cm 3495.

NERA (1999) Rail Passenger Demand Analysis. Prepared for OPRAF.

Operational Research, British Railways Board (1989) The Effect of Generalised Journey Speed (Q) on Demand in Network SouthEast. Memo 10215/M2.

Oscar Faber TPA (1993) Setting Forth Revealed Preference and Stated Preference Models. Prepared for Scottish Office.

Robbins, D. and White, P. (1985) Deregulation of Express Coach Services: Has the 1980 Act Worked, in Transport UK 1985, edited by A. Harrison and J. Gretton, Policy Journals, Newbury, Berkshire.

Steer Davies Gleave (1993) Review of South East Price Sensitivity. Prepared for Network South East.

Steer Davies Gleave (1999) National Passenger Demand Forecasting Framework. Prepared for Association of Train Operating Companies and Railtrack, London.

Toner, J.P and Wardman, M. (1993) Network SouthEast Off-Peak Inter Urban Mode Choice Model II. Technical Note 334, Institute for Transport Studies, University of Leeds.

TRL, Centre for Transport Studies University College London, TSU University of Oxford, ITS University of Leeds, Transport Studies Group University of Westminster (2004) Demand for Public Transport: A Practical Guide.

TPA (1992) TransPennine Rail Strategy Study: Study Report. Prepared for GMPTE, Merseytravel, SYPTE, WYPTE, Cheshire County Council, Derbyshire County Council, Humberside County Council, Lancashire County Council and Peak park.

Vicario, A. (1999) Diversion Factors and Cross Elasticities. MA Dissertation, Institute for Transport Studies, University of Leeds.

Wardman, M. (1993) Effects of Coach and Car Competition on Rail Elasticities: Empirical Findings from a Direct Demand Model. Technical Note 348, Institute for Transport Studies, University of Leeds.

Wardman, M. (2005) Public Transport Values of Time. Transport Policy.

Wardman, M. and Shires, J. (2004) Review of British Fare Elasticity Evidence. Paper Presented at World Conference on Transport Research, Istanbul.

Wardman, M. and Whelan, G. (1995) South East Competitive Modelling. Technical Note 380, Institute for Transport Studies, University of Leeds.