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Introduction

The objective of this work is to apply economic analysis to urban public transport, at both a theoretical and an empirical level, in order to assess efficiency in terms of both production and consumption. Our study is the first attempt to look systematically at this issue for urban transport at the European level. In so doing we aim to identify the organisational and regulatory features of systems that are efficient in both production and consumption.

Our starting point is an admittedly simplified classification of three broad types of regulatory structure in urban public transport in Europe.

1. Regulated, publicly owned monopolies (`the classical model'). This is the dominant organisational form in 10 member states (AT, BE, DE, ES, LU, GR, IE, IT, NL, PT), although there may be in these states some cities that have variations on this regulatory structure (e.g. regulated, private monopoly) or may have an alternative regulatory structure (e.g. some cities in ES have network management contracts).

2. Limited Competition Models. This has a number of variants. The two most common are the Scandinavian model, based on minimum cost tenders at a route level and represented in three member states (DK, FI, SE), with a variant also in Norway, and the French model, based on network management contracts.

3. Deregulated, Free Market Models. This is dominant form in GB outside London. In London route based tendering has been implemented.

Theoretical research

Our theoretical analysis has been based on two broad methodologies: Principal-Agent Analysis (PAA) and Micro-Economic Simulation Models (MESMs). Our key finding from PAA is that private firms are likely to be more effective in maximising profits due to incentives provided by take-over constraints, bankruptcy constraints, shareholder monitoring and lack of interference from politicians and civil servants. Management Employee Buy Outs (MEBOs) are likely to be transient phenomena unless restrictions are made to selling the business on. MESMs suggest that public intervention is required to maximise welfare due to user economies of scale (user benefit from increased service levels) and second best arguments (subsidy required to offset the impact of congestion, accidents and environmental pollution by cars). In a case study it is shown that profit maximisation can reduce net economic benefits by between 44% and 54% compared to perfect planning. Our conclusion from this part of our work is therefore that deregulated firms are potentially efficient in terms of production but not in terms of consumption. Regulated firms are potentially efficient in terms of consumption but not in terms of production.

Other key findings from our theoretical research include the following.

Firstly, distinction should be made between three functional levels: the strategic level (what do we want to achieve?), the tactical level (what product can help achieve the aims?) and the operational level (how do we produce the product?).

Secondly, there are a number of issues concerning contract specification and selection method (competition-for-the-market). PAA suggests that competitive tendering may be the most appropriate selection method for operational level decisions but may be less appropriate for tactical and strategic level decisions where experience acts as a barrier and external factors are important. In terms of contract specification, PAA suggests net subsidy contracts should be more efficient than full cost contracts but this assumes perfect knowledge and/or risk neutrality, neither of which are likely to apply in real life situations. Empirical evidence is therefore required.

Thirdly, there are a number of issues concerning open access (competition-in-the-market). MESMs suggest that in certain instances competition may increase net social benefit, where it leads to new products (e.g. the Arlanda Airport Rail Link, Manchester Metrolink) or new pricing structures. However, our MESMs also suggest that competition may reduce net social benefit where it leads to duplication of services or excessive price wars. Again empirical evidence is required.

Empirical research

This work was based on the ISOTOPE quantitative database which consisted of data on 207 public transport operators from 108 cities. The emphasis was on the development of performance indicators and elasticity estimates. A summary of the key indicators for bus and rail based systems is given by Table E1.

TABLE E1: SUMMARY OF KEY INDICATORS.

	Bus	Rail
Cost Recovery Ratio	0.51	0.37
Fare per Pass Km (Ecus)	0.08	0.11
Mean load (Pass)	22	40
Cost per Pass Km	0.24	0.47
Wage Rate (Ecus per annum)	29437	33564
Non staff cost per Vehicle Km	1.27	5.3
Revenue per Vehicle Km	1.28	1.85
Cost per Vehicle Km	2.6	7.48
Vehicle Km per Staff	17336	11241

Table E1 indicates that bus systems have a much higher cost-recovery ratio and vehicle km per member of staff than rail systems and much lower cost per passenger km, wage rates, non staff cost per vehicle km and cost per vehicle km. By contrast, rail systems can charge higher fares per passenger km (reflecting advantages in terms of speed) and have higher mean loads (reflecting the use of larger vehicles). Nonetheless, rail costs per passenger km are 96% higher than those of bus, whilst revenue per passenger km is only 38% higher than bus. This may suggest that there is some inefficiency in consumption in that high fare:high quality rail systems are being used in situations where lower fare:lower quality bus systems may be more appropriate. However, it should be noted that our sample excludes the European Union's largest cities (London and Paris) where rail may be most appropriate.

In Table E2 we make some comparisons for bus systems between the three regulatory forms we have identified. Our results indicate that regulated markets may be effective in terms of consumption in that load factors are 62% higher than those in deregulated markets and 127% higher than those found in limited competition markets. This may not however indicate efficiency. It may indicates that too few bus services are being produced at too low fares.

The financial effectiveness of deregulated systems is also evident. On average, they cover 85% of costs, compared to 47% for both limited competition and regulated markets. Again this does not necessarily signify efficiency. It may indicate that subsidies are too low in deregulated markets.

In terms of cost efficiency, the costs per vehicle km for deregulated systems are 52% less than those for regulated systems and 36% lower than those for limited competition systems.

In terms of labour productivity, the best performance is posted by the limited competition systems where vehicle kms per member of staff is 8% higher than in deregulated markets and 18% higher than in regulated markets, although this may reflect variations in input prices.

Overall, there is some support for the hypotheses that regulated markets are efficient in terms of consumption, deregulated markets are efficient in terms of production and limited competition markets are somewhere in between.

TABLE E2: COMPARISON OF KEY INDICATORS FOR URBAN BUS SERVICES

	R/TC	PK/VK	VK/SN	TC/VK
Deregulated GB	0.85	16.7	17,987	1.44
Limited Comp. DK,FR,FI, NO,SE	0.47	11.9	19,383	2.26
Regulated AT,BE,DE, ES,GR,IE,IT,LU, PT,NL	0.47	27.0	16,387	2.97

R = Revenue, TC = Total Cost, PK = Passenger Kms, VK = Vehicle Kms,
SN = Staff Numbers

Macro-economic considerations related to the Maastricht agreement, should lead to reductions in public transport subsidy levels. However, there is no sign of such convergence at present. Analysis of the finances of urban public transport in 52 cities in the early 1990s, failed to indicate any convergence in terms of financial performance. Although relative subsidy went down in 25 cities, it remained stable in 13 and actually increased in 14 cities.

TABLE E3: SUMMARY OF QUALITY INDICATORS

	Regulated	Limited Comp.	Deregulated
Supply	-	0	+
Network Design	0/+	0/+	-
Effectiveness	0	0/+	-
Convenience	0	0	-
Environmental	0	0	-
Speed	0	0	0
Security	0/+	0/+	-
Affordability	+	0	-
Delivery	0	+	0
Customer Opinions	0	+	0

+- = Positive performance, - = Negative performance, 0 = Neutral performance

An important issue relates to the quality of output. The three broad organisational forms were assessed in terms of 10 quality indicators, the first eight of which relate to strategic and tactical functions, and the last two of which relate to operational functions. The results are summarised by Table E3. Our results are qualitative but what they suggest is that regulated systems have advantages of affordability but low fares may result in inadequate investment and low levels of supply. These results may reflect the political context rather than the organisational structure. By contrast, deregulated regimes may perform well in terms of supply indicators but less well in terms of most other indicators. Models of limited competition may have quality advantages, particularly if contracts include appropriate incentives. The opinion surveys seem to confirm the perceived efficiency and effectiveness of limited competition models.

Econometric analysis was undertaken in order to determine elasticity estimates. Due to data limitations, and despite the use of additional data collected by Wunsch, this work was limited to bus systems. A translog model of operating costs was developed based on 56 observations. This model indicated an elasticity of cost with respect to vehicle kms of 1.16 and an elasticity of costs with respect to line km of 0.25. This suggests for the average system mild diseconomies of both density (return to density of 0.86) and scale (return to scale of 0.71). Our model suggests that the optimal fleet size is around 100 vehicles. It is interesting to note that large bus companies are emerging in Europe based on subsidiary companies of around 100 vehicles. These companies are attempting to simultaneously have the advantages of being big (which allows purchasing power in terms of fuel, vehicles and capital and may allow economies of scale in terms of marketing) and being small (which allows operating costs to be minimised). Our translog model also indicates a labour input elasticity with respect to price of -0.34, a capital input elasticity with respect to price of -0.18 and an elasticity of substitution between capital and labour of unity. This indicates strong substitutability between capital and labour. The last key finding of our translog model is that cost for Great Britain are 56% below those of the rest of Europe, even when output and input prices are held constant.

A log-linear model of demand was also developed based on data for the bus systems in 89 cities. This indicated an elasticity of demand with respect to fares of -0.50 for small cities and -0.34 for large cities. The corresponding elasticities of demand with respect to service were 0.33 and 0.49. The model indicated higher than average levels of demand in German and Swiss cities and lower than average levels of demand in France.

Empirical analysis of tendering suggest that cost reductions of between 10% and 20% can be achieved if there is no restructuring, whilst reductions of 35% or more can be achieved if there is also restructuring (fragmentation and privatisation). Studies in Great Britain indicate that minimum cost contracts may reduce subsidy by 13% compared to minimum subsidy contracts provided there is strong competition. Evidence from Sweden suggests cost plus contracts may increase costs by 18% compared to fixed cost contracts. Swedish data also suggests that moving from one bid per contract to two reduces costs by 12%, moving from one bid to three reduces costs by 17% and moving from one bid to four bids reduces costs by 20%.

British data indicates that vehicle size and age specifications may increase subsidy by 5-10%, whilst Swedish data suggests that including penalties for late running increases costs by around 30%.

Conclusions

Deregulated markets have theoretical and empirical advantages in terms of efficiency of production. Regulated markets have theoretical and empirical advantages in terms of efficiency in consumption. Limited competition markets may have advantages of both. Overall, we find some support for the Citizens' Network Green Paper's preference for some form of limited competition model. However, the main advantage of such models is not "to provide an environment which gives operators an incentive to raise standards whilst safeguarding system integration" (although they can do this) but in increasing efficiency in production whilst maintaining or improving efficiency in consumption. Work Package Three's work suggests that in some areas, reductions in unit operating costs of up to 50% are possible. Where redundancies and wage reductions are not possible these reductions will reduce to around 15% but are still likely to be the main gain of introducing competitive tendering to commercialised but publicly owned and/or regulated operations. These cost savings could then be used to improve the quality of public transport services, the quality of other public services or to reduce taxation. In order to make such gains, it may be necessary to restructure the bus industry in many member states and to develop and enforce appropriate competition policy.

Further Work

Finally, it is worth making a number of points that should be addressed by future researchers. Firstly, our work has been effected by a number of data problems that stem from a lack of consistent data on urban transport operations at a European level. There were a large number of comparability issues that the ISOTOPE database, given its limited resources, was unable to overcome. Given the large amounts of taxpayers money that urban public transport receives it would be in the public interest for a consistent set of data to be collected so that assessments of value for money could be made. Any move to comprehensive competitive tendering would require such a database to be constructed.

Secondly, we have outlined at least three forms of competitive tendering that could be applied to urban public transport. We believe that future work should make a more detailed assessment of these three forms and explore the large number of possible variants. The link between organisational and regulatory structure should be also explored in more detail.

Thirdly, in considering the trade-off between efficiency in production and consumption it is clear that the former is more readily measurable than the latter. This may have resulted in an over emphasis on cost cutting at the expense of quality improvements. Consumer surplus (expressed as per passenger km) might be considered as a possible summary measure of efficiency in consumption.

Fourthly, some of our simulation work raised important issues. The Arlanda study indicate that further information is needed on the extent to which public transport improvements can abstract demand from the car and the extent to which it can generate brand new trips. The Manchester study indicated the need for more detailed data on the variation of network capital and operating costs for both passenger and vehicle kms.

Improved Structure and Organisation for Urban Transport Operations of Passenger in Europe (ISOTOPE)

Final Report on Work Package 3 (Economic Research)

CHAPTER 1

Nature And Contents Of This Report

The objective of this work package is to apply economic analysis to urban public transport, both at an empirical and a theoretical level, in order to assess efficiency in terms of both production and consumption. By efficiency in production, we mean producing a given level of output at minimum cost. By efficiency in consumption, we mean that outputs and prices are set so as to maximise economic efficiency.

This final report is an upgraded version of the interim report presented to the seminar on "Facts and Opinions on Urban Public Transport in the European Union" in Lisbon on 3-4 October 1996 and is structured as follows.

In section 2, we consider the relevance of economic theory to organisational and regulatory issues in urban public transport. We begin in section 2.1 by developing a classification of regulatory structures and, in section 2.2, we go on to analyse how principal-agent theory may explain some of the success of privately owned firms in urban public transport. In section 2.3, we show how principal-agent theory may also be used to design contracts between the public and private sector. In section 2.4, we assess the role of public and private sector bodies in urban public transport. In section 2.5, we go on to use competition simulation models to assess the impact of new services in Stockholm and Manchester.

In section 3, we consider the role of empirical analysis in addressing organisational and regulatory issues in urban public transport. We use the ISOTOPE database developed by Work Package One, supplemented by other documentary databases. In section 3.1, we develop some partial factor productivity measures, whilst in section 3.2 and 3.3 we examine financial indicators and quality indicators. In section 3.4 and 3.5, we examine operator costs and demand respectively. Lastly, in section 3.6, we consider the role of franchising, using data from a variety of sources.

We end in section 4 by drawing a series of conclusions from both our theoretical and empirical work and make some recommendations for further work.

CHAPTER 2

Theoretical Research

2.1 Classification of regulatory structures

Work undertaken by van de Velde and Van Reeven (1996) suggests that there are three fundamental questions:

- What is the most desirable functional division between authorities, planners and operators?
- What is the most desirable contract form?
- What is the most adequate method to select operators?

These questions will be considered in turn.

2.1.1 Functional divisions

It is generally accepted that planning and control systems within companies can be divided into hierarchically ordered types of activities which differentiate themselves according to the scope of the planning issues addressed and the planning horizon. Anthony (1965) was probably the first to introduce a framework in which planning and control processes are divided into three hierarchical activities. Anthony (1988, p. 30-40) defined them as follows (although the boundaries of these processes are not totally sharp):

- Strategic planning is the process of deciding on the goals of the organisation and the strategies for attaining these goals.
- Management control is the process by which managers influence other members of the organisation to implement the organisation's strategies.
- Task control is the process of assuring that specific tasks are carried out effectively and efficiently.

Various words are used to denominate these hierarchical levels of planning and control activities (see, e.g., Hellriegel and Slocum, 1986). In our work we will use the following definitions:

- **Strategic level:** strategic management is involved in the formulation of general aims and in the determination in broad terms of the means that can be used to attain these - in short: *what do we want to achieve?*
- **Tactical level:** makes decisions on acquiring means that can help reaching the aims, and on how to use these means most efficiently -in short: *what product can help achieving the aims?*
- **Operational level:** makes sure the orders are carried out, and that this happens in an efficient way - in short: *how do we produce that product?*

2.1.2 Contract form

One of the objectives of contracts in public transport is the distribution of responsibilities between the parties to the contract. An important element is the allocation of financial risks between buyer and seller because some allocations can be more expensive than others. Also, the addition of financial incentives can help realise the objectives of the buyer.

Two types of risks can be distinguished in the situation that a governmental agency orders public transport services from a supplier:

Production risk: risk associated to the production costs of a fixed production quantity, independent of the amount of passengers.

Revenue risk: risk associated to the sale of transport services.

These risks can be allocated in different ways. The different possible allocations of risks give rise to the following distinction of contracts:

Gross cost contract: In this type of contract the production risk is born by a transport company while the revenue risk is born by the tendering authority. An agreed price will be paid for the production of a fixed amount of services. Revenues accrue to the tendering authority. The difference between realised costs and anticipated costs (the price) is for account of the firm while the difference between actual and anticipated revenues is for account of the tendering authority.

Net cost contract: In this contract both production and revenue risk are born by the transport company. The difference between anticipated total operating costs and revenues determines the price the tendering authority pays to the transport company. A realised difference between costs and revenues that does not correspond to the anticipated difference between costs and revenues is for account of the transport company.

Management contract: The management contract is the mirror image of the net cost contract because in the management contract both production and revenue risk are born by the tendering authority instead of the transport company. The manager of the transport activities receives a remuneration which is independent of his achievements.

Besides these three types of contract, all kinds of variants are possible. The success of contracts will be determined by the incentive structure including those incorporated in the contract (basic incentives) and those provided by other regulatory instruments (additional incentives), for example provided by competition policy. In addition, a distinction should be made between discrete incentives (e.g. the award of a contract) and continuous incentives (e.g. performance bonuses or penalties).

2.1.3 Choice of selection method

The choice of selection method may be split between no selection method (based instead on historic rights), selection methods based on negotiation, some form of competitive tendering and market competition. Important questions concern ensuring reasonable selection costs, choosing bids that vary in service quality the treatment of non-compliant bids and the publication of information in order to ensure fair competition (Van de Velde and Sleuwaegen, 1996).

2.1.3.1 Difference between tendering and franchisin

Both in a tendering and in a franchising process several potential operators bid for the right to operate in a certain area for a specific time period according to clearly defined contractual rules.

We define the main difference between tendering and franchising to be the larger scope for the operators (winning bidder) to modify the product or production size under a franchising agreement. Also, on average, a franchising agreement will impose more risks on the operator than a tendering contract.

In short, in a tendering situation the operator produces what has been asked for. While in a franchising situation, the operator behaves more like an entrepreneur while still following a number of ground rules which have been agreed upon at the letting of the contract.

2.1.3.2 Difference Between Contracting and Tendering/Franchising

The difference between contracting and tendering/franchising resides in the selection procedure used by the principal who selects the agent.

In a tendering/franchising procedure the agent is selected according to a competitive procedure which respects a number of objectivity rule. In a contracting situation the agent is selected according to the private preferences of intuition of the principal.

2.1.4 Integration of the three dimensions

Based on allocation of risks, four types of competitive tendering can be envisaged (see Table 2.1.1):

- Subsidy contracts result in the operator taking both the revenue and the production cost risk. This is the dominant form of tendering used for socially necessary services in the English Metropolitan (big city) areas
- Cost contracts result in the operator taking the production cost risk and the authority the revenue risk. This is the dominant form of tendering used for socially necessary services in the English Shire (small city and rural) areas.

- Hybrid contracts where risks are shared between operators and authorities. Examples include Adelaide (Australia) and Helsingborg (Sweden).
- Management contracts where risks are borne by the authority. This form is common in France but often complemented with additional contractual incentives.

TABLE 2.1.1: RISK AND CONTRACT TYPES

		PRODUCTION RISK BORN BY		
		AGENT (TRANSPORTER)	**(BOTH)**	**PRINCIPAL (PTA OR PTE)**
REVENUE	**AGENT (TRANSPORTER)**	NET COST CONTRACT		
RISK	**(BOTH)**	**(NET COST CONTRACTWITH SHARED REVENUE RISK) (GROSS COST CONTRACT WITH REVENUE NCENTIVES)**	**(MANAGEMENT CONTRACT WITH PRODUCTIVITY ANDREVENUE INCENTIVES)**	
BORN BY	**PRINCIPAL (PTA OR PTE)**	GROSS COST CONTRACT	**(MANAGEMENT CONTRACTWITH PRODUCTIVITY INCENTIVES)**	MANAGEMENT CONTRACT

Based on this analysis and analysis of the types of bodies responsible for strategic, tactical and operational functions, four forms of market organisation can be identified as providing alternatives to the classic, regulated model:

- The Scandinavian model - essentially based on a mixture of minimum subsidy and minimum cost contracts at a route level (also London)
- The French model - based on network management contracts with additional contractual incentives
- The Adelaide model - intermediate contracts where operators have some freedom to develop services
- The Market Competition model, which accounts for 85% of bus services in Great Britain, outside London.

These four models are represented by Tables 2.1.2 to 2.1.5 respectively.

These forms of market selection may form part of a deregulatory progression i.e. the Scandinavian model is an initial step, the Adelaide model is a second step and the market competition model is a third (and final) step.

An important issue is whether theoretical analysis of these organisational forms can prescribe which are optimal (in an economic sense). Such analysis suggest that competitive tendering is unlikely to be adequate at the tactical level because local experience will act as a barrier to entry and external factors are difficult to forecast (although planning authorities do often make use of external contractors, such as consultants). At an operational level competitive tendering of some form should be adequate, although even here there may be constraints where the incumbent lacks market discipline and there are few potential entrants. Theoretical analysis is less useful in determining what types of competitive tendering are optimal. Here empirical research is likely to be more fruitful.

TABLE 2.1.2: TENDERING FOR THE PRODUCTION OF PRE-DETERMINED SERVICES (The Scandinavian Model)

ACTOR	REGIONAL AUTHORITY (RTA)		REGIONAL TRANSPORT COMPANY (RTC)	BUS COMPANIES	RAIL, METRO OR TRAM COMPANIES
TYPE	**POLITICAL BODY**	**REGIONAL TRANSPORT DEPARTMENT**	**PUBLICLY OWNED REGIONAL COMPANY**	**PRIVATELY OWNED COMPANIES**	**PUBLICLY OR PRIVATELY OWNED COMPANIES**
RELATION	**UNDER DEMOCRATIC CONTROL**	**HIERARCHICALLY CONTROLLED BY THE POLITICAL BODY**	**MANAGEMENT CONTRACT WITH RTA**	**CONTRACT WITH RTC AFTER TENDERING**	**CONTRACT WITH RTC AFTER NEGOTIATION**
MODE OF TRANSPORT	**ALL**		**ALL**	**BUSES**	**RAIL**
STRATEGIC	**TRANSPORT POLICY**				
	SOCIAL POLICY				
	(DISCUSSION)	**STANDARDS OF ACCESSIBILITY**	**(SUGGESTIONS)**		
	(DISCUSSION)	**(SOCIAL) STANDARDS OF MOBILITY**	**(SUGGESTIONS)**		
TACTICAL			**FARES**		
			ROUTES		**(SUGGESTIONS)**
			TIMETABLE		**(SUGGESTIONS)**
			VEHICLE TYPE		**(SUGGESTIONS)**
OPERATIONAL			**VEHICLE ROSTERING**	**(SUGGESTIONS)**	**VEHICLE ROSTERING**
				PERSONNEL ROSTERING	**PERSONNEL ROSTERING**
				PERSONNEL MANAGEMENT	**PERSONNEL MANAGEMENT**
				VEHICLE MAINTENANCE	**VEHICLE MAINTENANCE**

TABLE 2.1.3: NETWORK MANAGEMENT CONTRACTS
(The French Model)

ACTOR	REGIONAL AUTHORITY (RTA)		REGIONAL TRANSPORT COMPANY (RTC)	BUS COMPANIES	RAILWAY COMPANIES
TYPE	**POLITICAL BODY**	**REGIONAL TRANSPORT DEPARTMENT**	**PRIVATE NETWORK MANAGER / TRANSPORT COMPANY**	**PRIVATELY OWNED COMPANIES**	**PUBLICLY OR PRIVATELY OWNED COMPANIES**
RELATION	**UNDER DEMOCRATIC CONTROL**	**HIERARC-HICALLY CONTROLLED BY THE POLITICAL BODY**	**CONTRACT WITH RTA AFTER TENDERING**	**CONTRACT WITH RTC AFTER TENDERING**	**CONTRACT WITH RTC AFTER TENDERING**
MODE OF TRANSPORT	**ALL**		**ALL**	**BUS**	**TRAIN**
STRATEGIC	**TRANSPORT POLICY**				
	SOCIAL POLICY				
	(DISCUSSION)	**STANDARDS OF ACCESSI-BILITY**			
	(DISCUSSION)	**(SOCIAL) STANDARDS OF MOBILITY**			
TACTICAL		**(MIN. STANDARD)**	**FARES**		
		(MIN. STANDARD)	**ROUTES**		**(SUGGESTIONS)**
		(MIN. STANDARD)	**TIMETABLE**		**(SUGGESTIONS)**
		(MIN. STANDARD)	**VEHICLE TYPE**		**(SUGGESTIONS)**
OPERATIONAL			**VEHICLE ROSTERING**	**VEHICLE ROSTERING**	**VEHICLE ROSTERING**
			PERSONNEL ROSTERING	**PERSONNEL ROSTERING**	**PERSONNEL ROSTERING**
			PERSONNEL MANAGE-MENT	**PERSONNEL MANAGEMENT**	**PERSONNEL MANAGEMENT**
			VEHICLE MAIN-TENANCE	**VEHICLE MAIN-TENANCE**	**VEHICLE MAINTENANCE**

TABLE 2.1.4: TENDERING OF PRE-DETERMINED SERVICES WITH RE-DESIGNING INCENTIVES

(The Adelaide Model)

ACTOR	REGIONAL AUTHORITY (RTA)		REGIONAL TRANSPORT COMPANY (RTC)	BUS COMPANIES	RAIL, METRO OR TRAM COMPANIES
TYPE	**POLITICAL BODY**	**REGIONAL TRANSPORT DEPARTMENT**	**PUBLICLY OWNED REGIONAL COMPANY**	**PRIVATELY OWNED COMPANIES**	**PUBLICLY OR PRIVATELY OWNED COMPANIES**
RELATION	**UNDER DEMOCRATIC CONTROL**	**HIER-ARCHICALLY CONTROLLED BY THE POLITICAL BODY**	**MANAGEMENT CONTRACT WITH THE RTA**	**CONTRACT WITH RTC AFTER TENDERING**	**CONTRACT WITH RTC AFTER NEGOTIATION**
MODE OF TRANSPORT	**ALL**		**ALL**	**BUS**	**RAIL**
STRATEGIC	**TRANSPORT POLICY**				
	SOCIAL POLICY				
	(DISCUSSION)	**STANDARDS OF ACCESSIBILITY**	**(SUGGESTIONS)**		
	(DISCUSSION)	**(SOCIAL) STANDARDS OF MOBILITY**	**(SUGGESTIONS)**		
TACTICAL			**FARES**		
			(MIN. STANDARD)	**ROUTES**	**ROUTES**
			(MIN. STANDARD)	**TIMETABLE**	**TIMETABLE**
			(MIN. STANDARD)	**VEHICLE TYPE**	**VEHICLE TYPE**
OPERA-TIONAL				**VEHICLE ROSTERING**	**VEHICLE ROSTERING**
				PERSONNEL ROSTERING	**PERSONNEL ROSTERING**
				PERSONNEL MANAGE-MENT	**PERSONNEL MANAGEMENT**
				VEHICLE MAIN-TENANCE	**VEHICLE MAINTENANCE**

TABLE 2.1.5: FREE COMPETITION, MARKET BASED MODEL
(The British Model)

ACTOR	TRANSPORT COMPANIES	REGIONAL AUTHORITY (RTA)		TRANSPORT COMPANIES
TYPE	**PRIVATELY OWNED COMPANIES**	**POLITICAL BODY**	**REGIONAL TRANSPORT DEPARTMENT**	**PRIVATELY OWNED COMPANIES**
RELATION	**IN COMPETITION ON THE FREE MARKET**	**UNDER DEMOCRATIC CONTROL**	**HIERARCHICALLY CONTROLLED BY THE POLITICAL BODY**	**CONTRACT WITH RTA AFTER TENDERING**
MODE OF TRANSPORT	**ALL**	**ALL**		**ALL**
STRATEGIC	**GENERAL AIMS**	**TRANSPORT POLICY**		
	AREA	**SOCIAL POLICY**		
	TARGET GROUPS	**(DISCUSSION)**	**STANDARDS OF ACCESSIBILITY**	
	GENERAL PRODUCT FEATURES	**(DISCUSSION)**	**(SOCIAL) STANDARDS OF MOBILITY**	
TACTICAL	**FARES**		**FARES**	
	ROUTES		**ROUTES**	
	TIMETABLE		**(MIN. STANDARD)**	**TIMETABLE**
	VEHICLE TYPE		**(MIN. STANDARD)**	**VEHICLE TYPE**
OPERATIONAL	**VEHICLE ROSTERING**			**VEHICLE ROSTERING**
	PERSONNEL ROSTERING			**PERSONNEL ROSTERING**
	PERSONNEL MANAGEMENT			**PERSONNEL MANAGEMENT**
	VEHICLE MAINTENANCE			**VEHICLE MAINTENANCE**

2.1.5 The positive and negative effects of each model

1) The Scandinavian model

Positive Effects:
- Strong incentives to productive efficiency.
- Service integration is easy to realise.

Negative Effects:
- Weak incentives to respond to passenger demand due to the absence of systematic competition at the tactical level.
- Danger for regulatory capture of the regional authority by the regional transport company.

2) The French model

Positive Effects:
- Easy integration of services.
- Easy transfer of personnel and installations.

Negative Effects:
- Limited incentives for productive efficiency.
- No possibility for simultaneous comparison of performances.
- Huge tendering costs for bidders.
- Danger for growing asymmetry of information.
- Danger for an excessive orientation towards the private preferences of contract awarding politicians.

3) The Adelaide Model

Positive Effects:
- Possibility to compare transporters' performances simultaneously.
- Small units can be tendered without loss of integration.
- Incentives for both productive efficiency and demand responsiveness.

Negative Effects:
- Danger for excessive definition of minimum services by the authority.

4) The British Model

Positive Effects:
- Direct response to market demand without authority intervention.
- Clear separation of functions and focus of the authority on the social aspects.
- Possibility for several authorities to intervene simultaneously.
- No or few border problems.

Negative Effects

- Danger for the appearance of unfair competition (need for an adequate regulation of competitive practices)

2.2 Principal-Agent Theory and Commercial Public Transport Services

The Principal-agent (P-A) problem is: "... a situation in which a principal (or group of principals) seeks to establish incentives for an agent (or group of agents) who take decisions that effect the principal, to act in ways that contribute maximally to the principal's own objectives". (Vickers and Yarrow, 1988).

The P-A problem arises whenever a firm/organisation (whether private or public) is managed and owned by different sets of people with non converging objectives and the presence of asymmetric information. The principal (the owner of the firm) wants to induce the agent (the firm's manager) to act in his (the principal's) interests, but because of asymmetric information the agent is not fully informed about the circumstances and the behaviour of the agent. There is a monitoring problem.

Faced with this problem the crux of P-A theory is therefore what is the optimal incentive scheme for the principal to enforce for the agent? For a full discussion of P-A theory see Rees, 1985, for now the following discussion will suffice.

There are two versions of the basic P-A model, the first assumes that the agent can observe the state of the world when choosing his actions and the other assumes he can't. Both models have the following constructions:

P - is the utility function of the principal.
G - is the utility function of the agent.
ã - is the agent's action.
Ø - is the state of the world.

The principal cannot observe either ã nor Ø, but is able to observe the outcome x(ã, Ø), the agent's action given Ø, and makes his own action (payment to agent), denoted ý, a function of the observed outcome.

Therefore the problem facing the principal is to choose ÿ(x), the incentive scheme for the agent. He faces two constraints whilst choosing, firstly, that the agent will behave selfishly and secondly, the incentive scheme must be sufficiently attractive for the agent to participate.

If the agent cannot observe Ø at the time of his actions then he will choose ã to maximise his expected utility given ÿ(x). If the agent is risk neutral then the optimum incentive scheme takes a simple form with the principle receiving a 'flat payment' from the agent regardless or what occurs. However, if the agent is risk averse then the principal must offer some insurance for bad states of the world. This will dull the agent's incentives, since he gains only part of the benefit resulting from extra effort on his part. The agent may therefore use the asymmetry of information to reduce his overall effort.

If the agent can observe Ø before taking his action then the agent's strategy given the incentive scheme ÿ(x) will then be a function of a(Ø) since the best action will depend upon circumstances. As before, the principal must also ensure that the incentive arrangement is sufficiently attractive for the agent to want to take part in it. The basic model can be applied to a wide variety of relationships but will vary in terms of the external constraints and pressures applied to both the principal and the agent.

For an urban transport firm providing commercial services, the owners' (the principals') objective is to maximise their expected financial return (profit) from the company. The principal's problem, as outlined earlier, is to ensure that the optimal incentive scheme is in place to ensure that its agents (its managers and other employees) carry out this objective.

P-A theory suggests that the problem facing the principal is that the agents' utility is likely to be a function, principally, of income and effort. Other secondary variables might include the firm's sales revenue, growth rate and the level of managerial discretion (all of which can be equated to power and prestige). Given the presence of asymmetry of information, it is clear that the agents will have an incentive to pursue their own objectives at the expense of the principals.

The theory however suggests that private firms are more effective in enforcing an optimal contract because they have a number of incentive mechanisms that do not exist for public firms. In particular, these include:

- Shareholder Monitoring - Particularly when share ownership is concentrated.
- Take-over Constraint - Assuming that take-overs are triggered by a management team not maximising expected profits and not for other reasons, e.g. increasing a firm's power or reducing a firm's tax liabilities (King, 1986).
- Bankruptcy Constraint - Bankruptcy leadsto the loss of control of a firm by the management and is akin to a take-over in that respect. The tightness of the constraint will largely depend upon the differences between the maximised expected value of the firm's debt level. The effectiveness of the constraint increasing the lower the difference.

Moreover, public firms are affected by:

- Politicians' incentives - Primarily electoral success and secondary upon income, power, effort etc.
- Civil Servant's Incentives - Based upon their department size, effort and prestige.

At the extreme, where the firm is owner-managed the P-A problem should not exist. A case study of a British bus firm has been undertaken. This firm was privatised in October 1988 as an Employee Share Ownership Programme in which eight senior managers held 51% of the shares and employees held 49%. it was sold on to a stock exchange listed bus group (or plc - public limited company) in May 1994, see Figure 2.2.1 for a diagrammatic relationship.

Figure 2.2.1 The Evolving P-A Relationships

	Principal	Agent	
(1)	Shareholders (Local Authority) ---------------------------	Managers	
(2)	Shareholders (49% employees & 51% management) ---------------------------	Managers	
	Principal	**Agent 1**	**Agent 2**
(3)	Shareholders (Plc) -----------------------	Managers (Plc) ----------------------	Managers (Operator)

Initially, there was a steady increase in operating profits rising from 4.5% of turnover in 1987-88, when still in public ownership, to 9.0% in 1990-91 (see Table 2.2.1). This however fell back to around 6% in 1992/3 and 1993/4 and may explain the take-over of the company in 1994. Under the new owners (FirstBus) profits are believed to have increased to a reported 15% in 1995-96.

Whilst shareholding has become more dispersed, during the period under examination, the take-over constraint has tightened (under the ESOP any take-over required 68% of shareholders to agree), whilst under the ESOP it seems likely that both managers and employees will have had some non-profit related objectives, e.g. working conditions. It certainly is evident that in Great Britain most ESOP's have been relatively short lived, with there being strong incentives to sell due to favourable initial sale prices and inadequate claw back provisions (Wright et al., 1992). This suggests that the P-A relationships in ESOPs and similar forms of management employee buy-outs may not be sustainable in a commercial environment.

In conclusion, the case study could be said to support the initial suggestions that private firms are more effective in achieving the principal's objective of maximising profit. Whether they are quite so effective in optimising other criteria, such as social welfare, is possibly another matter.

TABLE 2.2.1: FINANCIAL PERFORMANCE.

Year	1987 -88	1988 -89	1989 -90	1990 -91	1992 -93	1993-94
Ownership Type	PTA	ESOP	ESOP	ESOP	ESOP	ESOP
Turnover	£60 million	£30.1 million	£74.5 million	£83.3 million	£79.2 million	£80.0 million
Operating Profit	£2.7 million	£1.6 million	£4.1 million	£7.5 million	£4.9 million	£5.0 million
Retained Profit	£-1.1 million	£188,000	£177,000	£2.16 million	£4.5 million	£2.4 million
Op. Profit :Turnover	0.045	0.053	0.055	0.090	0.062	0.063
Acquisitions	none	2 bus operators	3 bus operators	none	none	none

2.3 Principal-agent theory and contracted public transport services

Muren (1996) analyses three contractual forms: full cost (= minimum cost contracts), net cost (= minimum subsidy contracts) and contracts with measured service quality included as an explicit variable. The objective is to minimise costs subject to a minimum level of service. Using an analytical framework associated with Lewis and Sappington (1991) and Laffont and Tirole (1993), it is shown that under the full cost contract the operator must make some profit even after a competitive bidding process, otherwise it would pay the operator to cut service quality. By reducing the length of contract periods this profit, which is a transfer from the authority to the operator, can be reduced. The net cost contract gives, in principle, a possibility to achieve the desired level of service quality with a lower profit accruing to the operator. This is because the operating firm loses in two ways if it cuts quality of service: it will not get its contract renewed and it will lose fare revenues. The net cost contract thus gives the operator stronger incentives to produce quality of service. However, if there is high variation in the number of passengers, the net cost contract may require compensating the operator for taking the risk. Such compensation reduces the relative advantage of the net cost contract over the full cost contract. The incentive contract with quality made explicit in the contract resembles the net cost contract in that it is risky for the operator. These contracts may be useful to the extent that it is possible to find variables that are easy to measure and for which the operator can predict the effect of investment in service quality with relative certainty.

Another important area of theoretical study is the application of auction theory to explain bidding strategies (see Kennedy, 1995 for a useful summary). In particular, at least two types of auctions are possible. Independent value auctions occur where bidders have different valuations for the good being auctioned. For example, a bus company will require lower amounts of subsidy if the contract fits in well with existing work or can be easily served from an existing depot compared to a bidder for whom these characteristics do not apply. In such a case, the bid will increase (i.e. the amount of subsidy will decrease) as the number of bidders increases. Common value auctions occur where all bidders have the same valuation of the good being auctioned but are uncertain about the value of that good. In such auctions, they may increase their bids as the number of bidders increases in order to win the auction but if they do this they may run the risk of the winner's curse. In other words, they may over-estimate the value of the good being auctioned and pay more for it than it is worth. To avoid the winner's curse, bidders may be particularly cautious when there are a large number of bidders. The two effects cancel out and in a common value auction bid price is not expected to vary with the number of bidders. It may be expected that revenue from a given bus service with fixed fares would have a common value for bidders.

A number of other aspects of auction theory may be worth considering. Vickrey auctions award contracts to the highest bidder based on the price of the second highest bidder. This is believed to reduce strategic bidding and could have a role in public transport. A two stage bidding process with separate bids based on price and quality could be considered (referred to in the literature as the Brook's Law procedure). Menu auctions are also possible, whereby, for example, bidders make bids for routes separately and in various combinations. This enables bidders to exploit economies of scope but also allows scope for strategic behaviour.

2.4 The role of the public and private sector

Jansson (1994a) highlights four main arguments for public intervention in public transport.

(i) The user economies of scale argument for a single route which is associated with Mohring (1972) and arises because as usage of public transport increases so will the benefits to existing users through increased frequencies and greater network density.

(ii) The intra-marginal demand argument. Private operators will invest, at the margin, where profits are highest. Investments will be concentrated on elastic markets and, except in cases of perfect price discrimination, will reject investments in inelastic markets where the main benefit will be to existing users.

(iii) The user economies of scale argument for a network. There may be a number of benefits of operating an integrated network (Cottham, 1986). The main effect is that the frequency and price of one route will effect the frequency and price and hence user benefits on rival (competing and complementary) routes. This will need to be taken into account if the objective is to maximise net economic benefit (i.e. benefit to producers, consumers and society as a whole).

(iv) The second-best argument for public intervention. This is the most common argument for public intervention and states that where car and public transport are competing modes (i.e. substitutes), if car is priced below marginal social cost then public transport should also be priced below marginal social costs. The first best solution is, of course, to ensure that car covers its marginal social cost.

These four features provide an argument for public intervention in terms of financial support, but not necessarily in terms of public planning and operation. Gwilliam (1987) lists a number of other reasons including operator economies of scale, public good characteristics, merit good characteristics and information imperfections.

Jansson analyses the first three of these effects for a single corridor which initially consists of one operator providing a service along the corridor's entire length. Subsequently, a second operator enters the market but only supplies services on the corridor's inner section (this may be thought of as a form of cream skimming). The analysis assumes that the market is otherwise protected from both actual and potential competition. His simulation results are presented in Table 2.4.1. This analysis indicates that welfare maximisation without a budget constraint is the optimal result, but this assumes lump-sum subsidy. If the shadow price of public funds is greater than 1.21 (and there is some evidence to suggest that this is the case), then welfare maximisation subject to a break-even constraint is the optimal policy. Compared to this policy, profit maximisation by one operator leads to a 150% increase in fares, a 33% decrease in service levels and a 37% decrease in net social benefit. Where a second operator enters on part of the route, net social benefit reduces by a further 17%. This is because those travelling along the entire length of the route disbenefit from the reduced frequency offered by the incumbent (an example of the Mohring effect in reverse).

TABLE 2.4.1: PRIVATE V PUBLIC SECTOR ANALYSIS : SIMULATION RESULTS

		Price per km	Frequency	Demand	Consumer Surplus	Producer Surplus	Net Social Benefit
1	**Welfare maximisation /one operator No budget constraint**	0	6.3	792	7920	-2520	5400
2	**Welfare maximisation /one operator Break-even constraint**	4	4.9	486	4860	0	4860
3	**Profit maximisation /one operator**	10	3.3	218	2180	860	3040
4	**Profit maximisation /two operators**						
	Incumbent	10	2.6	158			
	Entrant	10	2.3	50			
	Total	10		208	2002	510	2512

TABLE 2.4.2: STRENGTHS OF ARGUMENT AGAINST PRIVATE SECTOR RESPONSIBILITY

	Local and Regional Transport	Long-distance Transport
User Economies of Scale	Strong	Weak
Intra-Marginal Demand	Strong	Strong
Network Effects	Strong	Strong/Weak
Second-Best Effects	Strong	Weak

Jansson goes on to consider the role of these effects for local and regional public transport on the one hand and long-distance public transport on the other. His findings are summarised in Table 2.4.2. It is concluded that the free market solution in the public transport sector will not imply optimal solutions. The arguments for public sector involvement are, however, greater for urban and regional transport than long-distance transport. Furthermore, the user economy of scale arguments will be strongest for urban, regular services where passengers turn up at stops at random rather than use timetables (see also Jansson, 1993 and Tisato, 1995). Similarly, network effects and second-best effects are likely to be greatest in urban areas with their denser public transport networks and greater levels of road congestion, accidents and pollution. Furthermore, intra-marginal effects may be weaker in those long distance sectors where price discrimination is practised (e.g. airlines, railways).

Although the analysis suggests that free markets are not optimal i.e. that private sector responsibility is limited, it does not prove that the public sector is necessarily more efficient. Particular problems relate to inappropriate public choices concerning investments, prices and frequencies which may lead to inefficiencies in consumption (see, for example, Nilsson, 1991) and the lack of incentives for both planners and operators which may lead to inefficiencies in production (see, for example, Kim and Spiegel, 1987). Given the short-comings of both total public and total private responsibility for public transport, particularly in urban areas, it is recommended that competitive tendering may be beneficial.

Jansson (1996) extends his analysis to assess the impact of first best pricing for private transport (through introducing road pricing). From a case study of Stockholm, he concludes that the current second best prices for both public and private transport result in higher than optimal levels of congestion, accidents and environmental degradation, lower than optimal public transport services (and lower than optimal prices) and an excess burden on the economy due to the large amounts of subsidy required. Introducing a first best policy of central area road pricing, public transport fare increases and service improvements leads to net benefits of almost SEK900m (around 125m ECUs) per annum. The main gainers are taxpayers, the economy as a whole (through reduced externalities and excess burden), business motorists, bus users within the inner city and lorries. The main losers are private motorists and public transport users to and from the inner city. The implication of this work is that some form of public control may be required for both public and private transport, at least in terms of finances.

2.5 Competition - simulation models

2.5.1 Stockholm - Arlanda airport

In this section competition between public and private operators on the link between Stockholm city and the Arlanda airport is discussed. The purpose of this case study is to study competition between different operators.

In Sweden the state railway has been divided into a railtrack authority (Banverket) and an operating state monopoly, Statens Järnvägar (SJ). Since 1 July 1996, there is free competition on the rail network for goods transport, but passenger transport services are still monopolised for long distance services. The line Central Stockholm-Arlanda airport which will be operated from 1999 is the only long distance service line with competition for SJ. The distance between the city terminal in central Stockholm and Arlanda airport is approximately 40 km. The city terminal is where the national rail lines, many long distance coaches and local buses, underground lines and meet.

The purpose of the study is thus to analyse competition between a) ordinary (subsidised) public transport service, that is the regional public transport authority Stockholm Transport's (SL) network of commuter trains, underground and buses, b) airport shuttle buses operated by Flygbussarna AB, a ”company” owned by SL, c) commercial state owned Swedish State Railways (SJ) services and d) commercial private train services (A-train). Consequences are described in terms of user benefits and losses, producer gains or losses plus external effects. Specifically it is of interest to consider the incidence for business travellers and private travellers respectively.

In 1995 about 3.4 million trips were made on the Arlanda shuttle buses (including working trips) of which 2 million refer to the bus from the city terminal. Some companies at the airport subsidise their employees for use of the airport shuttle to get to/from work, implying that about 400 000 trips on the shuttle buses are works trips. In this analysis we do not consider these trips, since the magnitude of them and the choice of mode depends on the employers policy. According to existing forecasts, in 2005 about 6,6 million long-distance travellers will travel by public transport to Arlanda airport, thereof 67% are business travellers and 33% private travellers. About 12,8 million travellers use taxi or private cars. We assume fixed public transport demand.

The values of time used are recommended by the Swedish Institute for Transport and Communications Analysis, SIKA, for national infrastructure planning. Business travellers are assumed to have the value of time (VOT) 140 SEK/hour. Private travellers are assumed to have the value 70 SEK/hour. Note that the fairly high value refers to long-distance travel, which is used here, assuming that passengers value time the same for the long-distance part of the journey as for the access to the airport.

In the case **Base_B** passengers going to Arlanda airport can choose between two public transport alternatives: the shuttle airport buses and SL's local network with commuter trains connected to a local bus to Arlanda. The travel time between the Central station and the airport is about 60 minutes using the SL network and 40 minutes going by airport shuttle bus. The number of departures is adjusted to the increased demand (compared to the frequency today). It may be that the current pricing policy of Flygbussarna AB is not optimal from a welfare point of view. Case **Base_Bm** (for Base modified) thus assumes that the pricing policy of the city-Arlanda bus is changed so that total revenue exceeds total cost by some 10%. Even though this price structure may not be optimal, it is probably closer to the optimum than the current situation. In the analysis changes are related to the two base cases.

From 1999 there will be competition from the private consortium operating a shuttle train (called A-train) between the Central station in Stockholm and Arlanda airport. The travel time between the Central station and the airport will be approximately 20 minutes and the trains are assumed to run every 15 minutes. This case is called **case BA** (for Bus and A-train). **Case BrA** (for Bus reduced and A-train) assumes that the frequency for the bus service from the city terminal are reduced by 42%, due to lower demand.

It is expected that the private railway A-train will enjoy competition from the Swedish State Railways (SJ). This situation will be simulated in **case BAS** (Bus, A-train and SJ-trains). Compared to the A-train the SJ services would have the advantage to be connected to the national railway system. There have been discussions on whether the shuttle bus service should be allowed to compete with A-train and SJ-trains from the city terminal. For this reason a situation is simulated where the shuttle bus services from the city terminal are abandoned. This case is called it is considered **BaAS** (for Bus abandoned, A-train and SJ-trains).

TABLE 2.5.1: CASES

Case	Operator	Dep. per h	time (min)	Fare (SEK)
Base_B	SL commuter train and bus	4	60	10 per route
	Bus city-Arlanda	12	40	60
Base_m	SL commuter train and bus	4	60	10 per route
	Bus city-Arlanda	12	40	35
BA	SL commuter train and bus	4	60	10 per route
	Bus city-Arlanda	12	40	60
	A-train city-Arlanda	4	20	90
BrA	SL commuter train and bus	4	60	10 per route
	Bus city-Arlanda	6	40	60
	A-train city-Arlanda	4	20	90
BAS	SL commuter train and bus	4	60	10 per route
	Bus city-Arlanda	12	40	60
	A-train city-Arlanda	4	20	90
	SJ train Central station-Arlanda	1	22	1 class 90, 2 class 60
	SJ train Södertälje-Arlanda	3	22	1 class 195, 2 class 120
BaAS	SL commuter train and bus	4	60	10 per route
	A-train city-Arlanda	4	20	90
	SJ train Central station-Arlanda	1	22	1 class 90, 2 class 60
	SJ train Södertälje-Arlanda	3	22	1 class 195, 2 class 120

Table 2.5.1 summarises the cases, with number of departures and riding time and fares from the city terminal in Stockholm to Arlanda. Generally the full prices for business trips are reduced with respect to VAT (12%) and another 30% to take into account discounts and the companies' profits due to improved transport services, implying that prices are reduced by 38%:

- The average fare paid by private travellers using SL's public transport services is SEK 10 per route. For business trips the price after tax deduction is SEK 6.2 per route used.
- According to existing information the A-train fare is assumed to be SEK 90, including VAT 12 % for private travellers. For business trips the price after 38% tax deduction is SEK 55.
- The above mentioned extra fee of SEK 15 for the passengers going to/from Arlanda to the private consortium has been taken into account.

The costs per vehicle kilometre for the airport buses are assumed to be SEK 20/vehicle km. The operating costs for the A-train and the SJ-train include infrastructure user fees of SEK 6.4 per train kilometre based on 200 seats. The investment costs for the track funded by the Swedish National Rail Administration (Banverket) are SEK 2 000 million excluding. VAT. Since social costs shall be valued at consumer prices average indirect tax of 23% is added. The annual cost is then SEK 108 million per year assuming 60 years life length and a 4% real interest. The investment costs of SEK 1 000 million for the terminal at the airport are shared between the operators. These costs are joint costs (SEK 54 million per year) occur irrespective of whether A-train, SJ-trains or both use the terminal. It is assumed that the passengers who use SJ services to/from the Arlanda airport have to pay a fee of SEK 15 per passenger to the private Arlanda shuttle train consortium to cover the investment costs for the Arlanda train terminal.

The external costs for air pollution, exhaust gases, accidents and road maintenance, as recommended by the Swedish Institute for Transport and Communications Analysis (SIKA) are used in the calculations. The total external costs for the different modes are: bus 3,59 SEK/vehicle km per bus, train (four carriages assumed) 0,20 SEK/vehicle km and private car 0,64 SEK/vehicle km. It is assumed that the state receives SEK 0,37 less taxes per (unleaded) car kilometre when travellers shift from private car to public transport and car. 1,3 passengers per car are assumed.

In the base situation (Base_B) the airport shuttle bus from the city terminal is the most important mode. It is used for 78% of the 6,6 million trips (5,1 million trips) in 2005. The percentage increases to 82% when the fare for the airport shuttle bus is decreased from 60 SEK to 35 SEK (in Base_m). Only about 0,5 million travellers use the airport shuttle buses going from other places in Stockholm. When the A-train is introduced (case BA) the airport shuttle bus going between the Central station and Arlanda are looses about over 3 million passengers of their 5,1 million passengers. (in case B). This is due to the fact that 75% of the business travellers go by A-train to Arlanda. Only 1% of the private travellers choose the A-train.

When the airport buses reduce the frequency of the airport shuttle bus from 12 to 6 departures per hour and direction (in case BrA), 14% of the private travellers use the A-train. The number of trips performed on the local SL network to Arlanda is relatively constant in all cases. More than half of the private travellers and 30% of the business travellers go by SJ when their trains services are introduced (in case BAS). 50% of the business people stay on the A-train. If the airport shuttle does no longer have access to the city terminal (in case BaAS), nearly three quarters of the private travellers choose the SJ-train.

TABLE 2.5.2: TRIPS PER YEAR (2005) BY OPERATOR

Trips total	Base_B	Base_m	BA	BrA	BAS	BaAS
Bus city	5 179 942	5 442 103	2 017 511	1 329 054	1 043 511	0
Bus other	502 050	521 515	402 764	302 491	365 281	332 006
SL	921 767	640 141	715 423	928 139	408 264	411 303
A-train	0	0	3 468 061	4 044 075	2 289 419	2 848 598
SJ-train	0	0	0	0	2 497 284	3 011 852
Total	6 603 759	6 603 759	6 603 759	6 603 759	6 603 759	6 603 759

The business travellers benefit most from the introduction of A-train to Arlanda. This is due to their high value of time (140 SEK/h compared to 70 SEK/h) and due the fact that business people make two thirds of all travellers. The average weighted time for the business trips decreases by 4 % or SEK 10 when the A-train is introduced (compared to case B). For the private travellers the introduction does not mean an improvement in generalised costs at all.

Both business and private travellers are best off in case BAS when both A-train and SJ-trains are operated. The private travellers can improve their average weighted time by 16%, while the weighted time for the business people is reduced by 10%. The differences are slightly smaller when comparing case BaAS where the airport shuttle bus is no longer allowed to go to/from the city terminal with case B. When using Base_Bm as base case (where the shuttle bus fare is nearly halved) only the cases BAS and BrAS where the two rail operators offer their services are experienced as service improvements.

TABLE 2.5.3: CONSUMER SURPLUS IN SEK PER YEAR

	private	business	total
Base_m -Base_B	35	67	102
BA - -Base_B	0	47	48
BrA -Base_B	-8	38	30
BAS -Base_B	54	114	168
BaAS -Base_B	52	103	155
BA -Base_m	-34	-20	-54
BrA -Base_m	-43	-29	-72
BAS -Base_m	20	46	66
BaAS -Base_m	17	36	53

The overall revenues are highest in case BAS when airport shuttle bus, A-train and SJ-trains are offering their services (+47% compared to case B). In this situation the Flygbussarna reduced their revenues by about 80%. Taking into account also the operating costs including infrastructure user fees the following development for the producer surplus can be expected.

TABLE 2.5.4: OPERATORS' PRODUCER SURPLUS (INCL. TERMINAL INVESTMENTS) IN SEK PER YEAR

	Bus city	A-train	SJ-train	total
Base_m -Base_B	-92	0	0	-92
BA - -Base_B	-138	19	0	-120
BrA -Base_B	-108	60	0	-48
BAS -Base_B	-63	33	-43	-74
BaAS -Base_B	-113	30	-22	-105

In terms of operators' surplus best results are achieved when the airport buses, A-train and SJ offer their services. The surplus is larger compared to the modified base with reduced fares for the airport buses (Base_m) than compared to the situation today (Base_B). The losses are caused by the assumption of fixed demand. If the amount of travellers increase with 15% which is probably realistic the operators could cover their costs. SJ's bad result is due to the assumption that SJ has to pay 15 SEK per passenger have to the A-train consortium to cover the terminal investment costs.

The monetary value for the external costs is about SEK 22 million per year for the airport shuttle buses leaving every five minutes to/from Arlanda and SEK 0,5 million for the A-train or SJ-trains leaving four times per hour. Compared to the actual situation with only buss services to Arlanda the external costs are halved (SEK 11 million per year) when the number of bus departures is halved in case BrAS. The external costs are lowest in case BaAS where both trains are operating and the airport buses are abandoned from the city terminal.

In the cases with trains operating the investment costs of SEK 2000 million for the track funded by the state - the Swedish National Rail Administration (Banverket) are included. The costs per year are SEK 108 million assuming 60 years life length and a 4% real interest. The total welfare includes consumer and producer surplus, state surplus and external costs. When comparing the two base cases, the total welfare is slightly higher in case Base_m (+ SEK 10 million). This is due to the fact that trips are transferred from the local SL-network to the airport buses.

TABLE 2.5.5: TOTAL WELFARE (IN SEK PER YEAR)

	Consumer surplus	Producer surplus	State surplus	External effects	Total welfare
Base_m -Base_B	102	-92	0	0	10
BA - -Base_B	48	-120	-108	0	-180
BrA -Base_B	30	-48	-108	11	-115
BAS -Base_B	168	-74	-108	-1	-15
BaAS -Base_B	155	-105	-108	21	-37

Taking into account consumers and producers benefits and losses, the external costs and the state's track investment costs the total welfare worsens compared to the actual situation with the airport buses and the SL-network in all cases. The introduction of the A-train and the SJ-train is the case that means the smallest change in terms of total welfare (- SEK 15 million). This is caused by the annual investment costs of SEK 108 million and the operators' losses.

2.5.2 Manchester

A 216 zone model based on the hierarchical logit model has been developed to determine the impact of extending the Metrolink (tram system) in Manchester (Halcrow Fox, 1996A). Table 2.5.6 carries out some sensitivity analysis using this model. The results indicate that LRT (i.e. Metrolink demand) is less sensitive to fare and service quality charges than bus demand but increased bus competition can lead to significant reductions in LRT revenue. Table 2.5.6 also indicates the importance of trade-offs between producers and consumers. The success of the Manchester Metrolink scheme does though illustrate once again that there may be scope for increasing welfare through introducing new competitive services, particularly if the market is heterogeneous enough to permit product differentiation (see, for example, Preston, 1993).

Four further scenarios were tested as follows:

1. An integrated public transport system with a flat fare that operates throughout the network (as in Brussels);
2. An integrated structure but with a distance related fare structure based on zones (as in Rotterdam);
3. A network in which frequencies are doubled but route km held constant; and
4. A network in which frequencies are held constant but route km are doubled.

Their results are given by Table 2.5.7. It can be seen that integration of services provides benefits in terms of making public transport more attractive relative to car based travel, in particular by lowering fares, with public transport demand increasing by between 8% and 11%, whilst fares are reduced by between 17% and 33%. However, this leads to reductions in revenue of between 11% and 27% and therefore these policies are not commercially viable. Increasing frequencies and/or network coverage boosts patronage significantly (by between 9% and 22%) but never by an amount whereby the increases in revenue offsets the increases in operating costs. These policies are therefore not commercially viable either. The main conclusion to come from this analysis is that there is no "golden rule" for increasing the fortunes of urban public transport. All the scenarios tested involve trading off one aspect of public transport against another - for example, reduced subsidy usually implies higher fares and lower market share. However, this analysis does make the nature of the trade-offs explicit, thus allowing the policy maker to have a clearer idea of the choices that they may have available to them.

In the final three rows of Table 2.5.7, we have made some very crude estimates of changes in welfare, based on the assumption of linear demand curves and that in the base case operations are breaking-even. The percentages in these rows refer to total revenue. Thus in the flat fare scenario producer surplus reduces by 27% of total revenue, whilst consumer surplus increases by 35% of total revenue. Thus society is better off by an amount equal to 8% of total revenue, assuming that there are no external costs and benefits. In reality there may be some external benefits in terms of reduced congestion, accidents and environmental pollution, although these are likely to be relatively small. However, this assumes 11% increase in traffic can be carried with a zero increase in operating costs. In reality an increase in operating costs would be expected that would eradicate most if not all of the welfare gain. A similar situation exists with the distance related fare, although here society is only better off by an amount equivalent to 7% of total revenue, with patronage only increasing by 8%. By contrast doubling frequency is welfare inefficient, leading to a reduction equivalent to 28% of total revenue. Doubling network coverage, is more welfare efficient with an increase equivalent to 9% of total revenue. However, this would also imply substantial increases in capital costs as the LRT network would need to be doubled. In simplistic terms, the above suggests that price reductions in Manchester might lead to improvements in welfare but that service increases would not lead to improvements. This may in turn indicate that in Manchester fares and frequencies are too high: a price:output combination that is believed to be typical of many competed markets (see, for example, Evans, 1987).

TABLE 2.5.6: MANCHESTER INITIAL MODEL TEST RESULTS

Change in Output	Bus fare down 50%	Bus wait time down 50%	Bus interchange time down 50%	LRT fare down 50%	LRT feeder fare down 50%	LRT wait time down 50%	LRT interchange time down 50%	All down 50%	All fares down 50%	Flat PT fares
Bus passenger kms	79.4%	65.7%	4.2%	-36.4%	-12.8%	-31.3%	-11.9%	13.9%	0.4%	40.6%
LRT passenger kms	-11.3%	-8.7%	-0.6%	17.8%	4.5%	13.4%	4.3%	23.7%	15.0%	-7.2%
Total PT Passenger kms	**3.0%**	**3.0%**	**0.2%**	**9.2%**	**1.8%**	**6.4%**	**1.8%**	**22.2%**	**12.7%**	**0.4%**
Bus revenues	-12.3%	28.3%	2.1%	-7.6%	-28.4%	-5.3%	-1.0%	-34.7%	-44.0%	8.8%
LRT revenues	-11.3%	-8.5%	-0.6%	-40.3%	4.3%	14.1%	4.2%	-37.2%	-41.8%	-
Total PT Revenues	**-11.6%**	**1.4%**	**0.2%**	**-31.5%**	**-4.6%**	**8.8%**	**2.8%**	**-36.5%**	**-42.4%**	10.2%
PT mode share (number % points)	**1.8%**	**1.9%**	**0.1%**	**4.2%**	**0.7%**	**3.0%**	**0.7%**	**11.1%**	**6.0%**	**-5.0%** **-0.7%**
Consumer surplus for existing bus users (mins)	6.7	6.4	0.4	-	-	-	-	13.4	6.7	0.0
Consumer surplus for existing LRT users (mins)	-	-	-	9.8	1.8	6.3	1.8	19.8	11.6	0.1
Bus revenue per passenger km	-51.1%	-22.5%	-2.0%	45.3%	-17.9%	37.8%	12.3%	-42.7%	-44.3%	-22.%
LRT revenue per passenger km	0.0%	0.2%	0.0%	-49.3%	-0.3%	0.6%	-0.1%	-49.2%	-49.4%	-3.2%

TABLE 2.5.7: FINAL MANCHESTER MODEL TESTS

	Integrated PT and Flat Fare	Integrated PT and Distance Related Fare	Doubling of Service Frequency	Doubling of Network Coverage
Bus Passenger Kms	-8.7%	-13.4%	+18.2%	-33.5%
LRT Passenger Kms	+14.2%	+11.4%	+6.7%	+32.4%
TOTAL PASSENGER Kms	+10.6%	+7.5%	+8.6%	+22.0%
Bus Revenue	-2.7%	-15.8%	+16.2%	-2.0%
LRT Revenue	-35.5%	-9.4%	+7.4%	+34.4%
TOTAL REVENUE	-26.6%	-11.1%	+9.8%	+24.5%
Bus Operating Costs	0.0%	0.0%	+50.0%	+50.0%
LRT Operating Costs	0.0%	0.0%	+50.0%	+50.0%
TOTAL OPERATING COST	0.0%	0.0%	+50.0%	+50.0%
Bus operating subsidy	+0.3%	+2.0%	+30.7%	+31.8%
LRT operating subsidy	+5.7%	+1.5%	+31.9%	+29.8%
TOTAL SUBSIDY	+4.0%	+1.7%	+31.5%	+30.4%
PT MODE SHARE	+4.2%	+3.5%	+4.4%	+11.7%
Change in Producer Surplus	-26.6%	-11.1%	-40.2%	-25.5%
Change in Consumer Surplus	+34.9%	+17.9%	+11.9%	+34.3%
CHANGE IN WELFARE	+8.3%	+6.8%	-28.3%	+8.8%

CHAPTER 3

Empirical Results

3.1 Partial factor productivity and cost efficiency indices

Following the work of Mackie and Nash (1982) a series of indicators have been developed for urban public transport operations in Europe. The analysis was based on the ISOTOPE database developed by Work Package 1. Although this database is relatively comprehensive for bus it is less so for rail modes. Similarly, although coverage is good for some countries e.g. Spain and Sweden it is less so for others. Furthermore, the data affected by a number of outliers, which have had to be excluded.

Due to reasons of commercial confidentiality, the results are aggregated by geographic area and are presented in Table 3.1.1 for bus and Table 3.1.2 for rail-based modes (LRT/Tram, Underground and Suburban Rail). The results for bus are described below. It should be noted that our data has been aggregated to a city level with a number of cities having a number of operators. There are a maximum of 34 cities in our bus database:

- The average cost:recovery ratio is 0.51, with the highest results for the British Isles and Spain (somewhat surprisingly) and the lowest measures for Italy/Greece, France and the Benelux countries. This ratio may be thought of as the main financial productivity measure.
- The average revenue per passenger kilometre is 0.074 ECUs (at market exchange rates). France and the Nordic countries have the highest average revenues at around 0.154 ECUs, with Spain the lowest at around 0.035 ECUs.
- The average loading figure is 22 passengers. The loading for Spain is double this at around 48 passengers, high figures can also be seen for both Portugal and Italy/Greece. The lowest figure is that posted for the Nordic Countries at around 10 passengers. This measure may be thought of as a measure of commercial productivity but is likely to be affected by population density, car ownership etc.
- The average cost per passenger km is 0.24 ECUs and is highest for France and the Nordic countries and lowest for Portugal, Spain and the British Isles at 0.1 or less.
- The average staff costs are 29,437 ECUs per full time employee, with the highest wage/salaries being earned in the Benelux countries and the lowest in Spain.
- On average the non staff costs per vehicle km are 1.28 ECUs, with the highest costs being recorded for Germany and the Nordic countries and the lowest for Spain and the Benelux countries.
- Revenue per vehicle km averages 1.28 ECUs and is highest for France and is lowest for the Nordic countries.

- Total cost per vehicle km averages 2.24 ECUs and is highest for Germany and Italy/Greece but lowest for the British Isles and the Nordic countries.
- Lastly, vehicle kilometres per member of staff, which is a measure of staff productivity, averages 17,336 per annum, being highest for the Nordic countries and lowest for Spain.

TABLE 3.1.1: PRODUCTIVITY INDICATORS - BUS

Country		R / TC	R / PK	PK / VK	TC / PK	SC / SN	NSC / VK	R / VK	TC / VK	VK / SN
Benelux	M	*0.277*	*0.046*	*16.1*	*0.17*	*47990*	*0.53*	*0.8*	*2.94*	*19999*
	SD	0.117	0.017	2.35	0.017	8826	0.29	0.34	0.27	2634
	Ob	3	3	4	3	4	3	3	3	4
France	M	*0.253*	*0.151*	*14.0*	*0.68*	*31491*	*1.26*	*1.9*	*2.8*	*17351*
	SD	0.179	0.144	6.71	0.925	4143	0.47	2.6	0.97	2817
	Ob	4	5	5	4	4	4	5	4	5
Germany	M	*0.332*	*0.083*	*16.4*	*0.25*	*37121*	*1.84*	*1.30*	*3.95*	*17382*
& Austria	SD	0.107	0.045	2.95	0.08	11072	0.79	0.53	1.07	4061
	Ob	5	5	5	5	5	5	5	5	5
Italy & Greece	M	*0.3*	*0.04*	*22.9*	*0.16*	*34344*	*1.38*	*0.9*	*3.43*	*16036*
	SD	0.072	0.01	2.49	0.06	16088	0.30	0.11	0.11	4633
	Ob	3	4	5	3	3	3	4	4	3
Portugal	M	*0.61*	*0.053*	*32.1*	*0.086*	*27009*	*0.97*	*1.6*	*2.65*	*15802*
	SD	0.029	0.006	4.68	0.007	0	0	0.22	0.22	819
	Ob	4	4	3	4	1	1	3	3	3
Nordic	M	*0.686*	*0.154*	*9.7*	*0.47*	*28209*	*1.93*	*0.78*	*1.71*	*21415*
	SD	.0	0.017	5.06	0.27	7016	0.9	0.5	0.16	20440
	Ob	1	2	3	2	3	3	2	3	4
Spain	M	*0.831*	*0.035*	*47.5*	*0.043*	*12833*	*0.82*	*1.54*	*1.86*	*12714*
	SD	0.072	0.015	9.69	0.02	775	0.31	0.29	0.38	2454
	Ob	4	4	4	4	4	4	4	4	4
British Isles	M	*0.85*	*0.077*	*16.7*	*0.1*	*16500*	*1.43*	*1.42*	*1.44*	*17987*
	SD	0.09	0.006	4.74	0.02	4506	0.87	0.31	0.14	3503
	Ob	2	3	4	3	3	3	3	3	3
Average		*0.51*	*0.08*	*22*	*0.24*	*29437*	*1.27*	*1.28*	*2.6*	*17336*

Key:
R = Revenue per annum (ECUs)
PK = Passenger kms per annum
SC = Staff costs per annum (ECUs)
NSC = Non Staff Costs per annum
na = None available
TC = Total Costs per annum (ECUs)
VK = Vehicle kms per annum
SN = Staff Numbers
M = Mean average
Ob = Observations
SD = Standard Deviation

TABLE 3.1.2: PRODUCTIVITY INDICATORS - RAIL BASED MODES

Country		**R**	**R**	**PK**	**TC**	**SC**	**NSC**	**R**	**TC**	**VK**
		TC	**PK**	**VK**	**PK**	**SN**	**VK**	**VK**	**VK**	**SN**
Benelux	M	*0.249*	*0.071*	*24.7*	*0.545*	*39792*	*9.05*	*2.7*	*12.2*	*12743*
	SD	0.031	0	15.4	0.219	0	1.34	0.2	1.8	9877
	Ob	2	1	4	1	1	2	2	3	2
France	M	*na*	*na*	*68.3*	*na*	*na*	*na*	*na*	*na*	*3097*
	SD	na	na	37.3	na	na	na	na	na	0
	Ob	na	na	4	na	na	na	na	na	1
Germany	M	*0.3*	*0.055*	*20.3*	*0.199*	*36819*	*3.14*	*1.61*	*5.23*	*22795*
& Austria	SD	0.12	0.028	3.98	0.093	7766	2.17	1.07	2.42	8658
	Ob	7	7	9	9	8	7	8	8	8
Italy & Greece	M	*0.192*	*0.319*	*50.0*	*1.667*	*na*	*2.39*	*1.22*	*4.97*	*na*
	SD	0	0	47.0	0	na	0	0.26	0	na
	Ob	1	1	2	1	na	1	2	1	na
Portugal	M	*0.431*	*0.015*	*71.5*	*0.035*	*27995*	*na*	*1.40*	*3.25*	*15171*
	SD	0	0	14.4	0	0	na	0	0	0
	Ob	1	1	3	1	1	na	1	1	1
Nordic	M	*0.616*	*0.092*	*12.2*	*0.145*	*28631*	*0.24*	*1.41*	*2.11*	*10487*
	SD	0.067	0.039	7.1	0.048	1694	0	1.14	1.63	0
	Ob	2	2	2	2	2	1	2	2	1
Spain	M	*0.190*	*0.012*	*55*	*na*	*na*	*na*	*1.27*	*na*	*8005*
	SD	0	0.011	0	na	na	na	0	na	0
	Ob	1	2	1	na	na	na	1	na	1
British Isles	M	*0.61*	*0.21*	*18.6*	*0.23*	*34582*	*11.7*	*3.33*	*17.1*	*6392*
	SD	0	0	9.03	0	0	0	0	0	0
	Ob	1	1	1	1	1	1	1	1	1
Average		*0.37*	*0.111*	*40.1*	*0.47*	*33564*	*5.3*	*1.85*	*7.48*	*11241*

Key:
- R = Revenue per annum (ECUs)
- PK = Passenger kms per annum
- SC = Staff costs per annum (ECUs)
- NSC = Non Staff Costs per annum
- na = None available
- TC = Total Costs per annum (ECUs)
- VK = Vehicle kms per annum
- SN = Staff Numbers
- M = Mean average
- SD = Standard Deviation
- Ob = Observations

The results for rail-based systems are more tentative, given the non-availability of data and the diversity of systems (trams, underground railways and suburban railways). Nonetheless some useful comparisons can be drawn with the bus systems in our data:

- The average cost-recovery ratio for rail, at 0.37, is only two-thirds that of bus, whilst the revenue per passenger km for bus (0.08 ECUs) is around 70% that of rail (0.11 ECUs).
- The mean loads are nearly twice that for rail (40) as for bus (24).
- Average cost per passenger km for rail is, at 0.47 ECUs, roughly twice that of bus.
- Staff Costs at 33,564 ECUs per fulltime employee per annum, are around 14% higher than those for bus.
- Non-staff costs per vehicle km, at 5.3 ECUs, are more than four times higher for rail systems than for road. This reflects that rail systems have greater responsibilities for their track, traffic management systems and terminals than road based public transport systems.
- The receipts per vehicle km, at 1.85 ECUs are around 45% more than for bus systems.
- The total cost per vehicle kms for rail, at 7.48 ECUs is almost three times that for bus.
- The staff productivity, in terms of vehicle kms per member of staff at 6,957 is only 65% of that achieved by bus operators.

3.2 Cost and financial indicators

HFA produced a report for DGVII on the organisation and operation of urban public transport in the then 12 Member States of the Community (HFA, 1994). This work included the construction of fare box ratios (fares divided by operating costs) for a sample of 15 cities and is shown by Table 3.2.1. This work has been updated and extended to 52 cities and is shown by Table 3.2.2 (see also Halcrow Fox, 1996B). It should be noted that subsidy definition may not be consistent across cities in Table 3.2.2. For example, in the UK the fuel tax rebate that operators receive from central Government has not been included nor have concessionary fare reimbursements (which are subsidy to users not operators). Similarly, the subsidy received from the "versement" in France does not seem to be included.

Of the 52 cities in Table 3.2.2, 14 have seen a relative increase in subsidy levels, 13 have seen subsidy levels remain stable and 25 have seen relative declines in subsidy levels. Where subsidy levels have been increasing, this may be due to unfavourable external factors, principally economic recession, rising car ownership and decentralisation of urban activities. Where subsidy levels have been decreasing there are two principal causes. Firstly, declining operating costs due to tendering. In the 1990s the Scandinavian countries have introduced tendering with some marked reductions in relative subsidy levels (e.g. Gothenburg down 23%). In other Scandinavian cities, subsidy reductions have been achieved by fare increases as part of a policy to commercialise urban public transport operations. A policy of commercialisation has also been undertaken by STIB in Brussels which has resulted in
the cost recovery ratio increasing from 28% to 33% between 1982 and 1995. The main causes have been a 13% reduction in staff, a 3% reduction in vehicle kms and a 3% increase in passenger journeys.

Secondly, increasing revenue due to pro-public transport subsidies. This is particularly associated with the French system of "versement" coupled with private sector operators running network contracts. For example, relative subsidy levels have declined by 27% in the Lille region and 14% in Nantes, although elsewhere in France relative subsidy levels have been either stable or have increased. Alternative data for the Netherlands supplied by NEA suggests that for eight Dutch cities (Amsterdam, Rotterdam, Den Haag, Utrecht, Groningen, Nijmegen, Maastricht and Dordrecht) the average subsidy requirement has fallen from over 70% of operating costs to 56% between 1986 and 1994. This has been achieved through substantial increases in revenue, in response to pro-public transport policies mentioned, coupled with a 10% increase in operating costs.

Anderson (1993) notes, on the basis of Scandinavian evidence, that the process of change is almost impossible to bring about unless there is a strain on public budgets. It is possible that the conditions required for European Monetary Union within the Community will create these pressures. However, the present situation sees a divergence in the cost and financial indicators for urban public transport in European cities rather than a convergence. Many European cities are making efforts to promote public transport rather than cut costs. It is understandable why such a policy is popular with decision makers but it appears less effective than tendering in financial terms. There may be valid micro-economic reasons for such policy divergence, but it is possible that in the near future macro-economic considerations will promote convergence towards more overt cost cutting policies.

TABLE 3.2.1: FAREBOX RATIOS IN DIFFERENT EUROPEAN CITIES

City	Country	Operating Costs (Ecus 000)	Fare Revenues (Ecus 000)	Farebox Ratio
Antwerp	**Belgium**	51,257	21,110	0.41
Liege	**Belgium**	43,714	18,711	0.43
Brussels	**Belgium**	222,953	77,862	0.35
Aarhus	**Denmark**	41,409	29,733	0.72
Copenhagen	**Denmark**	227,517	122,691	0.54
Marseilles	**France**	109,446	72,467	0.66
Hamburg	**Germany**	398,775	239,683	0.60
Dublin	**Ireland**	134,338	144,511	1.08
Milan	**Italy**	494,834	148,363	0.30
Luxembourg	**Luxembourg**	25,534	8,932	0.35
Den Haag	**Netherlands**	125,972	37,539	0.30
Barcelona	**Spain**	243,507	128,465	0.53
Seville	**Spain**	47,228	24,880	0.53
Valencia	**Spain**	50,065	32,647	0.65
London	**UK**	1,333,860	1,272,198	0.95

TABLE 3.2.2: SUBSIDY AND COMMERCIAL INCOME RATES AS PERCENTAGES OF TOTAL OPERATING COST

		Subsidy as % of operating costs			Commercial income as % of operating costs		
City	**Country**	**93/94**	**94/95**	**95/96**	**93/94**	**94/95**	**95/96**
Vienna	Austria	47.7	47.7	59.9	0.3	0.3	0.3
Antwerp	Belgium	58.8	58.8	58.8	2.7	2.7	2.7
Brussels	Belgium	65.1	62	62	2.6	5	5
Charleroi	Belgium	68	68	68	3.1	3.1	3.1
Liege	Belgium	61	61.6	61.8	1.2	2.1	2
Copenhagen	Denmark	46	46	46	2	2	2
Bordeaux	France	62.4	62.4	63.2	3.4	3.4	3.2
Grenoble	France	38	38	38			
Lille/Roubaix/Tourcoing	France	46	46.5	33.5			
Lyon	France	49	52	52			
Marseille	France	41.3	36.7	40.6	1.6	1.6	7
Nantes	France	51.2	47.8	44	2	2	7
Paris	France	53	53	44.4	15	15	19.2
Aachen	Germany	26	26	26			
Berlin	Germany	61	61	57	6	6	10
Bonn	Germany	62.5	64	64			
Essen	Germany	55	66	66	12	5	5
Frankfurt	Germany	44	60	52.9			
Hamburg	Germany	38	38	46			
Karlsruhe	Germany	45.7	45.7	45.7			
Koln	Germany	47	47	55			
Magdeburg	Germany	70	70	52			
Munchen	Germany	48	48	48			
Nurenburg	Germany	62	65	69			
Stuttgart	Germany	55	55	55			
Athens	Greece	48	48	48	25	25	25
Dublin	Ireland	19	4.4	4.4			
Bologna	Italy	64	64	62	2	2	4.5
Milan	Italy	48.2	47.3	48	1.8	1.9	2.8
Rome	Italy	86.9	85.2	85.2	1.7	2.1	2.1
Bergen	Norway	30.2	23.2	17	6.6	3	4.2
Oslo	Norway	38	31	36	8	12	6
Lisbon	Portugal	31.9	31.7	30.9			
Barcelona	Spain	56.7	56.7	47.3	1.1	1.1	1.7
Barcelona	Spain	43	43	40.3	2.5	2.5	2.4
Madrid	Spain	30	35	34.5	2	2	1.6
Valencia	Spain	43	43	43	2.4	2.4	2.4
Goteborg	Sweden	70	60	54			
Malmo	Sweden	61.6	60	60	6.1	5	5
Stockholm	Sweden	64	64	58	6	6	8
Basle	Switzerland	15	15	15			
Bern	Switzerland	28.6	28.3	12	6.6	6.1	7
Geneva	Switzerland	47	56	54			7
Zurich	Switzerland	32	32		15	15	
Amsterdam	The Netherlands	77.5	77.5	70.2	0	0	4.9
Den Haag	The Netherlands	70.2	68.2	68.4	2.7	2.4	1.9
Rotterdam	The Netherlands	80	79.2	79.2			
Bristol	UK	8	8	8			
Glasgow	UK	28.3	16.7	16.7			
Leeds/Bradford	UK	27	27	27	3	3	3
Manchester	UK	23.4	25.6	25.6	6.4	5.1	5.1
Newcastle	UK	30	2	2	2	2	0

Source: Janes Urban Transport Systems 1993/4, 1994/5 and 1995/6

Note: Commercial income relates to off-vehicle income related to leasing of property, advertising & ancillary activities

3.3 Quality indicators

Based on our earlier, theoretical work, four main organisational forms could be assessed:

(i) The Classical, regulated model
(ii) The Scandinavian model of contracting out of operations
(iii) The French model of contracting out of planning and operators within guidelines established by Government
(iv) The deregulated, competitive model.

TABLE 3.3.1: EVALUATION OF FORMS OF ORGANISATION

	Classical	**Scandinavian**	**French**	**Deregulated**
Long-term vision	Government	Government	Government	Government (limited)
Network planning	Government, based on proposals from transport companies	Government	Transport company, within government guidelines	Market
Market mechanism in network planning and set-up of timetable	No	No	Yes	Yes
Operation	Concession appointed by government	Concession in competition	Concession in competition on network basis	Market
Market mechanism in operation	No	Yes	Yes	Yes

The characteristics of these four organisational forms are summarised by Table 3.31. A series of ten quality indicators have been detected. The first eight relate to the quality of network design and planning, whilst the last two relate to the quality of operation.

1. Supply measures such as vehicle kms, seat/place kms, route kms and vehicle kms per route km (density). In the classical model and the Scandinavia model, supply is under pressure. This is also true for the French model, except in certain cities where new modes have been introduced (tramways and VAL systems). With deregulated urban markets, supply is stronger. For example, in Great Britain vehicle kms have increased by 24% (Mackie, Preston and Nash, 1995) since deregulation. However, these increases are concentrated on busy routes and times and as a result there gaps in provision which need to be filled by tendering.

2. Network design and quality indicators. These may include percentage of passengers with direct route, average transfer times, the ratio of public transport distance to crow-fly distance, existence of integrated ticketing and schedule efficiency. It is believed that deregulated systems score poorly for these indicators, whilst the Scandinavian model also has relatively little incentive to improve these measures.

3. Effectiveness indicators such as journeys, trips, passenger kilometres and mode-split. It is believed that in deregulated systems lack of integrated supply can lead to decreases in effectiveness. For example, demand has decreased by 27% since deregulation in Britain, although the trend is also generally negative for the other three forms.

4. Comfort and Convenience indicators such as percentage of low floor buses, percentage of passengers seated, quality of stops, cleanliness, quality of available information, age of vehicles.

5. Environmental indicators such as the percentage of vehicle kms realised by environmental friendly techniques. It is believed that deregulated systems score poorly on categories 4. and 5., whilst in the other three models there may be a quantity/quality trade-off but scope exists for Governments to set quality standards.

6. Indicators of the quality of supply in terms of speed. Other measures include percentage of route kilometres with exclusive rights of way and percentage of traffic lights where public transport has priority.

7. Indicators of safety and personal security. An indicator of personal security may be provided by the percentage of stations that are staffed. Staffing levels come under particular pressure in deregulated regimes. This is also a problem area for the other organisational forms, although there have been some important initiatives developed under the French model.

8. Indicators of affordability such as average fare level per km, concessionary rates etc. Low tariffs are mostly found with the classical model (e.g. in Italy) but this may also result in low quality due to insufficient funds for investment. Within the French model, the transport company often has the opportunity to use tariff differentiation as a marketing instrument, whereas in the Scandinavian model tariffs are set by Government. Deregulation may lead to large increases in prices (e.g. up 17% in Great Britain).

9. Indicators of service delivery such as reliability (percentage of timetable trips cancelled), punctuality (percentage of timetable trips delayed by 5 minutes or more) and failures (e.g. escalators, ticketing systems, information). Contractual systems may provide incentives so as to improve service delivery.

10. Indicators of customer opinion. Attitudinal surveys may be undertaken to develop a quality index based on several items (e.g. Copenhagen). These surveys may be repeated amongst the same group of users to form a panel of data. Creation of a client platform/focus groups may also be useful.

From the ISOTOPE factual database we were able to produce a series of quality indicators for the following modes of bus, tram/LRT, underground and suburban rail. The following indicators were used:

- Vehicle kilometres per head of population (VK/P)
- Vehicle kilometres per route kilometre (traffic density VK/RK)
- Route kilometres per km^2 (network density RK/A)
- Passenger kilometres per head of population (PK/P)
- Mean Speed in the Peak (MSP)
- Mean Speed in the Off-Peak (MSO)
- The proportion of route kilometres that are bus lanes (RK/BL)

As in section 3.1 the database was relatively comprehensive for bus but far less so for the other rail based modes. Despite this Quality Indicators have been produced for all four modes and presented as a series of four tables. Due to reasons of commercial confidentiality, the results are aggregated by geographic area and presented as mean averages (M), standard deviations (SD) and the number of observations (Ob). All the measures are per annum.

The results for bus are presented in Table 3.3.2 and are as follows:

- The average number of vehicle kms per capita is 32.3 kms, this compares with the highest figure for the Nordic countries at 62 kms and the lowest for Spain and France at around 17-20kms.
- The average number of vehicle kms per route km is 37,722 kms. The highest is for the British Isles at almost 65,000 kms, suggesting a frequent service concentrated on a small network. France has the lowest figure at around 20,000 kms, followed by the Nordic countries with around 22,500 kms.
- Route kms per area km^2 averages out at 2.87 kms with the highest figures being posted by Portugal (7.87 kms) and Spain (4.76 kms), however, the high standard deviation for the last two would suggest that the data maybe somewhat unreliable. The lowest figure is posted by the Nordic countries at 0.46 kms. This reflects the low population densities in Nordic cities.
- Passenger kms per capita averages out at355 kms. The highest figures are for Portugal and the British Isles at 729 kms and 659 kms respectively, whilst the lowest figures are for Italy and Greece at 58 kms and France at 68 kms. We suspect that the French figures for passenger kms actually refer to passengers. If the mean trip length in France is 5 kms this would increase the French figure to 340 passenger kms per capita, which is close to the average. We think the same problem may exist with the Italy and Greece data. This problem will have affected

all our results for France, Italy and Greece where passenger kms are part of the index.

- The average mean peak speed by bus operators averages out at 17.6 kms per hour (kph), with the highest speeds being recorded by the Nordic countries (25.1 kph) and the lowest by Portugal at (10.9 kph).
- The mean off-peak speed is recorded at 20.8 kph around 3 kph faster than the mean off-peak speed. The highest speed is recorded again by the Nordic countries at 29.4 kph and the lowest by Portugal at 10.9 kph.
- The average percentage of route kms that are bus lanes is 2.25%. The lowest figure is recorded by the British Isles at 0.44% and the highest by the Nordic countries at 3.67%.

TABLE 3.3.2: QUALITY INDICATORS - BUS

Country		VKP	VKRK	RKA	PKP	MSP	MSO	RKBL
Benelux	M	*24.39*	*37944*	*1.13*	*225*	*21.6*	*21.9*	*0.43%*
	SD	5.44	20791	0.45	85.8	1.64	1.59	0.4
	Ob	6	6	6	6	6	6	6
France	M	*20.88*	*19688*	*1.40*	*68*	*16.47*	*17.37*	*2.58%*
	SD	5.94	10698	0.48	25.6	3.86	3.17	1.89
	Ob	2	2	6	2	5	5	6
Germany	M	*31.77*	*40760*	*2.14*	*376*	*20.67*	*22.71*	*2.06%*
& Austria	SD	13.9	15980	1.47	201	1.97	2.25	1.03
	Ob	7	7	7	7	6	7	4
Italy & Greece	M	*31.7*	*43449*	*4.01*	*58*	*14.86*	*17.72*	*3.4%*
	SD	6.65	30618	6.00	30.1	0.97	2.19	3.9
	Ob	5	5	4	3	5	5	5
Portugal	M	*36.81*	*na*	*7.87*	*729*	*10.93*	*14.75*	*2.93%*
	SD	16.33	na	9.86	304	2.13	2.75	2.52
	Ob	3	na	5	3	3	2	2
Nordic	M	*62.03*	*22510*	*0.46*	*567*	*25.1*	*29.41*	*3.67%*
	SD	24.2	12479	0.49	158	8	9.51	1.91
	Ob	6	5	4	6	6	6	4
Spain	M	*17.16*	*34856*	*4.76*	*157*	*11.35*	*14.4*	*2.47%*
	SD	5.23	15234	5.57	122	0.89	1.67	0.8
	Ob	4	3	4	4	4	6	2
British Isles	M	*33.97*	*64844*	*1.18*	*659*	*19.5*	*28.5*	*0.44%*
	SD	32.97	0	0.73	17.3	4.75	11.99	0.42
	Ob	2	1	3	2	4	4	2
Average		*32.3*	*37722*	*2.87*	*355*	*17.6*	*20.81*	*2.25*

The results for tram and light rapid transit are presented in Table 3.3.3 and are as follows:

- The average vehicle kms per capita is around 10.7 kms which is three times lower than for bus. The lowest figure is recorded by the British Isles at 1.6 kms and the highest by Germany at 37 kms.
- The average number of vehicle kms per route kms has an average figure of around 154,000 kms, around four times that for bus. The highest recorded figure is for France with around 445,000 kms, although the high standard deviation suggests that the figure for Germany may be more appropriate at 203,079 kms. The lowest figure posted is that for the Benelux countries at around 75,000 kms.
- Route kms per area km^2 averages out at 0.342 kms, with the highest figure being recorded by Germany at 0.383 kms and the lowest by the British Isles at 0.021kms.
- Passenger kms per capita has an average figure of 208 kms, with the highest figure being recorded by Germany (743 kms) and the lowest figure by the British Isles at 16.1 kms.
- The mean average off-peak speed is greater than the peak speed by around 3 kms. The lowest speeds are recorded by Italy & Greece and the highest by France.

TABLE 3.3.3: QUALITY INDICATORS - TRAM

Country		VK P	VK RK	RK A	PK P	MSP	MSO
Benelux	M	*6.87*	*74810*	*0.327*	*199*	*18.84*	*20.44*
	SD	4.61	22153	0.265	159	4.06	3.51
	Ob	3	3	5	5	5	5
France	M	*4.68*	*445688*	*0.028*	*na*	*26.65*	*26.65*
	SD	2.05	393569	0.017	na	8.35	8.35
	Ob	4	4	4	na	2	2
Germany	M	*37.16*	*203079*	*0.383*	*743*	*19.86*	*21.3*
& Austria	SD	19.63	28564	0.182	402	3.8	3.1
	Ob	7	7	7	7	7	7
Italy & Greece	M	*13.71*	*94581*	*1.12*	*40*	*11.4*	*15.3*
	SD	0	0	0	0	0	0
	Ob	1	1	1	1	1	1
Portugal	M	*1.81*	*118286*	*0.183*	*87.7*	*10*	*na*
	SD	0	0	0.150	0	0	na
	Ob	1	1	2	1	1	na
Nordic	M	*9.05*	*48864*	*0.332*	*162*	*19*	*20*
	SD	0	0	0.240	0	3	2
	Ob	1	1	2	1	2	2
Spain	M	*na*	*na*	*na*	*na*	*na*	*na*
	SD	na	na	na	na	na	na
	Ob	na	na	na	na	na	na
British Isles	M	*1.6*	*95412*	*0.021*	*16.1*	*26*	*26*
	SD	0.34	12652	0.003	0	4	4
	Ob	2	2	2	1	2	2
Average		*10.7*	*154389*	*0.342*	*208*	*18.8*	*21.6*

The results for the underground are presented in Table 3.3.4 and are as follows:-

- Vehicle kms per capita for the underground has an average figure of around 18.07 kms, nearly, twice that for tram and around 55% of bus. The highest figure is recorded by the Nordic countries and Germany at 32 kms and 31 kms respectively, whilst the lowest is recorded by France at 7.55 kms.
- The average number of vehicle kms per route kms is around 467,000 kms, significantly higher than for both bus and tram. The highest figure being recorded by Portugal at 752,000 kms, whilst the lowest is that for the Nordic countries at 152,000 kms.
- Route kms per area km^2 has an average figure of 0.087 kms, with the highest figure being recorded by the Benelux countries at 0.173 kms and the lowest from the Nordic countries at 0.021kms.
- Passenger kms per capita is 510 kms, the highest figure being recorded by Portugal at 868 kms, and the lowest 125 kms by Italy/Greece.

- The average peak and off-peak speeds are basically the same at around 29 kms per hour, considerably higher than for both bus and tram.

TABLE 3.3.4 : QUALITY INDICATORS - UNDERGROUND

Country		**VK P**	**VK RK**	**RK A**	**PK P**	**MSP**	**MSO**
Benelux	M	*11.23*	*266998*	*0.173*	*301*	*35*	*35.1*
	SD	3.05	96113	0.027	160	4.6	4.4
	Ob	3	3	3	3	3	3
France	M	*7.55*	*325040*	*0.06*	*na*	*18.3*	*18.3*
	SD	3.59	156560	0.019	na	0	0
	Ob	2	2	2	na	1	1
Germany	M	*31*	*714549*	*0.137*	*689*	*32.3*	*32.3*
	SD	5.79	109258	0.077	218	2.49	2.49
	Ob	3	3	3	3	3	3
Italy & Greece	M	*17.82*	*745753*	*0.156*	*125*	*29*	*30.3*
	SD	13.5	168830	0.108	32	0	0
	Ob	2	2	2	2	1	1
Portugal	M	*8.94*	*752479*	*0.025*	*868*	*33*	*na*
	SD	0	0	0	0	0	na
	Ob	1	1	1	1	1	na
Nordic	M	*32*	*152000*	*0.021*	*619*	*33*	*33*
	SD	0	0	0.001	0	0	0
	Ob	1	1	1	1	1	1
Spain	M	*17.93*	*309575*	*0.035*	*456*	*28.4*	*28.4*
	SD	0.551	0	0	0	0	0
	Ob	2	1	1	1	1	1
British Isles	M	*na*	*na*	*na*	*na*	*na*	*na*
	SD	na	na	na	na	na	na
	Ob	na	na	na	na	na	na
Average		18.07	466628	0.087	510	29.9	29.6

The results for suburban rail are presented in Table 3.3.5. This is the mode with the least coverage available, the results are as follows:-

- The average number of vehicle kms per capita is 10.5 kms, a figure similar to that for trams. The highest figure recorded is that for Germany at 18.8 kms, with the lowest being recorded by the British Isles at 2.82 kms.
- The average number of vehicle kms per route km is around 148,000 kms. The figures range from 23,382 kms (British Isles) up to 341,500 kms for Germany.
- Route kms per area km^2 averages 0.12 kms, below that for bus and tram but higher than for the underground. The highest figure recorded is that for Portugal at 0.2 kms and the lowest is that for the Nordic countries at 0.056 kms.
- Passenger kms per capita, averages 372 kms per annum, a similar figure to that for bus. The lowest figure is for the British Isles at 56 kms and the highest for Germany at 845 kms.

- The mean peak and off-peak speeds are quite similar at 45.2 and 48.3 kph respectively. These speeds are the highest of all the modes examined.

TABLE 3.3.5: QUALITY INDICATORS - SUBURBAN RAIL

Country		VK	VK	RK	PK		
		P	RK	A	P	MSP	MSO
Benelux	M	*na*	*na*	*na*	*na*	*na*	*na*
	SD	na	na	na	na	na	na
	Ob	na	na	na	na	na	na
France	M	*na*	*na*	*na*	*na*	*na*	*na*
	SD	na	na	na	na	na	na
	Ob	na	na	na	na	na	na
Germany	M	*18.8*	*341500*	*0.067*	*845*	*na*	*na*
& Austria	SD	7.76	0	0	188	na	na
	Ob	2	1	1	2	na	na
Italy & Greece	M	*na*	*na*	*na*	*na*	*na*	*na*
	SD	na	na	na	na	na	na
	Ob	na	na	na	na	na	na
Portugal	M	*4.41*	*80373*	*0.201*	*172*	*35.8*	*na*
	SD	0	0	0.085	0	0	na
	Ob	1	1	2	1	1	na
Nordic	M	*na*	*na*	*0.056*	*340*	*55*	*55*
	SD	na	na	0.015	0	0	0
	Ob	na	na	2	1	1	1
Spain	M	*14.15*	*na*	*na*	*445*	*45*	*45*
	SD	0	na	na	0	0	0
	Ob	1	na	na	1	1	1
British Isles	M	*2.82*	*23382*	*0.157*	*56.1*	*45*	*45*
	SD	0.405	2218	0.038	18.2	5	5
	Ob	2	2	2	2	2	2
Average		*10.05*	*148418*	*0.12*	*372*	*45.2*	*48.3*

The ISOTOPE opinion survey of authorities and operators has also provided some useful data (see Tables 3.3.6 to 3.3.9). The main findings were:

- In terms of efficiency and effectiveness (Table 3.3.6), the results for the classical model were mixed, the models with limited competition (France and Scandinavia) were believed to be both efficient and effective, whilst the deregulated system was not believed to be effective.

- Table 3.3.7 indicates that authorities regard the deregulated systems as difficult to manage, the French system encourages both innovation and cohesion between authorities and operators, the Scandinavian system has led to improvements, whilst the classical system has limited innovation and in some countries (e.g. Portugal) has led to a lack of clarity concerning the responsibilities of operators and authorities.

- Table 3.3.8 indicates that although most groups are believed to be satisfied with the classical and limited competition models, only operators in the United Kingdom are considered to believe that deregulation has had a positive effect.

- Table 3.3.9 shows that in both the classical and deregulated models quality management and control is believed to be the responsibility of the operator. In the French and Scandinavian models there is a greater tendency for the roles to be fulfilled by the authorities through minimum service standards, community impacts etc. Fare policy is generally considered to be the task of the authorities.

TABLE 3.3.6: OPINION OF THE AUTHORITIES ON EFFICIENCY AND EFFECTIVENESS

		Authorities			**Operators**	
		Classical model (NL, B, SP, P)	Limited competition (F, N, SW)	Deregulated (UK)	Classical model (NL, B, SP, P, D, I)	Limited competition (F, N)
Efficient	**Yes**	2	4	-	18	4
	Neutral	10	3	4	14	1
	No	1	2	1	5	-
Effective	**Yes**	4	8	-	21	4
	Neutral	9	-	2	16	1
	No	-	-	3	1	-

TABLE 3.3.7: THE OPINION OF THE AUTHORITIES AND OPERATORS ON THE CURRENT SYSTEM
(answers given by authorities)

	Authorities				Operators	
		Classical model (NL, B, SP, P)	Limited competition (F, N, SW)	Deregulated (UK)	Classical model (NL, B, SP, P,D,I)	Limited competition (F, N)
Encourage innovation	Yes	5	3	-	13	2
	Neutral	5	6	4	14	4
	No	6	1	1	20	1
Manageable	Yes	5	6	-	15	5
	Neutral	7	5	1	19	2
	No	3	-	4	10	-
Leads to improvements	Yes	5	6	1	15	3
	Neutral	9	3	1	18	4
	No	1	1	3	13	-
Impact on efficiency	Yes	5	6	2	25	4
	Neutral	8	4	2	12	2
	No	1	-	1	9	-
Impacts on level of patronage	Yes	4	6	2	18	3
	Neutral	3	4	1	17	4
	No	5	-	2	10	-
Impacts on the cohesion between authority and operator	Yes	10	5	2	21	6
	Neutral	3	4	1	19	1
	No	2	1	2	9	-
Impacts of effectivess	Yes	4	4	2	20	3
	Neutral	8	6	2	17	4
	No	3	-	1	6	-

TABLE 3.3.8: THE OPINION OF VARIOUS GROUPS ON THE CURRENT SYSTEM (ANSWERS GIVEN BY AUTHORITIES)

		Authorities			**Operators**	
		Classical model (NL, B, SP, P)	Limited competition (F, N, SW)	Deregulated (UK)	Classical model (NL, B, SP P, D, I)	Limited competition (F, N)
Authorities	Positive	3	5	-	21	5
	Neutral	3	5	3	17	1
	Negative	1	-	2	3	-
Operators	Positive	5	8	4	29	5
	Neutral	2	2	1	17	1
	Negative	-	-	-	1	-
Users	Positive	5	3		17	3
	Neutral	3	7	4	25	3
	Negative	1	-	1	3	-
Employers	Positive	4	5	1	17	1
	Neutral	3	5	3	24	4
	Negative	1	-	-	2	1
Trade unions	Positive	5	3	1	18	2
	Neutral	-	6	1	16	3
	Negative	1	-	3	6	1

TABLE 3.3.9: WHO SHOULD BE THE DECISION MAKERS IN QUALITY ASPECTS (ANSWERS GIVEN BY THE AUTHORITIES)

		Authorities			**Operators**	
		Classical model (NL, B, SP, P)	Limited competition (F, N, SW)	Deregulated (UK)	Classical model (NL, B, SP) (P, D, I)	Limited competition (F, N)
Overall transport policy	Authorities	13	10	4	25	4
	Neutral	3	-	1	21	3
	Operators	-	-	-	-	-
Minimum service standards	Authorities	10	8	5	12	4
	Neutral	6	2	-	16	1
	Operators	-	-	-	8	2
Community impact	Authorities	8	10	4	18	4
	Neutral	2	-	1	23	2
	Operators	-	-	-	1	-
Quality management and control	Authorities	7	5	-	3	2
	Neutral	4	5	3	21	3
	Operators	4	-	2	22	1
Information to the public	Authorities	-	4	1	2	-
	Neutral	6	3	3	15	-
	Operators	5	2	1	30	7
Fare policy	Authorities	7	9	3	12	3
	Neutral	2	1	2	20	3
	Operators	2	-	-	15	1

3.4 Operating cost analysis

The aim of this work was to examine the relationship between costs and outputs, input prices and measures of organisational and regulatory factors. This work was based on combining the 188 observations from the ISOTOPE database with 56 observations from the database compiled by Wunsch (1996A,B). This gave a combined data set of 244 cross sectional observations. The variables considered were: operating cost, vehicle kilometres, line kilometres, wage rate and vehicle price. In the event only 49 observations contained all five variables, with this figure increasing to 75 observations if only four variables (excluding line kilometres) were considered. This is because our data set is affected by both missing and extreme values. Our analysis was limited to bus services as an insufficient number of observations were available to undertake analysis for rail modes. A correlation matrix for the independent variables was examined. This indicated that there were no problems of multicollinearity. More details of this work are provided by Perez-Perez, 1996.

A translog model of the following form was estimated:

$$\begin{aligned}\ln C = {} & \alpha_o + \alpha_v \ln VK + \alpha_l \ln LK + \beta_l \ln P_l + \beta_k \ln P_k + \\ & \tfrac{1}{2}\delta_{vv}(\ln VK)^2 + \tfrac{1}{2}\delta_{11}(\ln LK)^2 + \tfrac{1}{2}\gamma_{11}(\ln P_l)^2 + \tfrac{1}{2}\gamma_{kk}(\ln P_k)^2 \\ & + \gamma_{lk} \ln P_l \ln P_k + \phi_{vl} \ln VK \ln LK + \rho_{v1} \ln VK \ln P_l + \rho_{vk} \ln VK \ln P_k + \\ & \rho_{11} \ln LK \ln P_1 + \rho_{lk} \ln LK \ln P_k + \psi DV\end{aligned}$$

where

C	=	Operating cost per annum
VK	=	Vehicle kilometres per annum
LK	=	Line kilometres per annum
P_l	=	Price of labour
P_k	=	Price of vehicles
DV	=	Dummy Variable (= 1 if city in Great Britain, 0 otherwise)

The following models were tested:

(I) No restrictions

(II) Homogeneity of degree one in input prices

$\beta_l + \beta_k = 1; \gamma_{11} + \gamma_{kk} = 0; \gamma_{lk} = 0; \rho_{vl} + \rho_{vk} = 0; \rho_{11} + \rho_{lk} = 0$

(III) Homotheticity (separability of inputs from outputs)

$\rho_{vl} = \rho_{vk} = \rho_{11} = \rho_{lk} = 0$

(IV) Linear separability test

$\gamma_{lk} = 0$

(V) Homogeneity and unitary elasticity of substitution (Cobb-Douglas)

$$\delta_{vv} = \delta_{ll} = 0; \gamma_{ll} = \gamma_{kk} = \gamma_{lk} = 0; \phi_{vl} = 0; \rho_{vl} = \rho_{vk} = \rho_{u} = \rho_{lk} = 0$$

Statistical tests, based on the log-likelihood ratios, supported models II and IV. As model IV is a special case of model II, model II was used for further analysis. This model is given by Table 3.4.1. One important finding was that we were unable to support a hypothesis of Cobb-Douglas production technology - a finding which is consistent with other studies (see, for example, Berechman, 1993, Table 5.2).

It should be noted that of the 15 parameter values estimated, only five are significant at the 5% level although this reflects the small number of degrees of freedom available. However, the model exhibits excellent goodness of fit, with 98% of variation being explained.

TABLE 3.4.1: PREFERRED TRANSLOG MODEL OF OPERATING COSTS

	Parameter Value	Standard Error
α_o	-13.276	19.67*
α_v	2.91	2.63*
α_l	-3.92	1.42
β_l	-1.45	2.07*
β_k	2.45	2.07*
δ_{vv}	-0.178	0.180*
δ_{ll}	-0.013	0.011*
γ_{ll}	-0.030	0.119*
γ_{kk}	0.030	0.119*
γ_{lk}	-	-
ϕ_{vl}	0.232	0.087
ρ_{vl}	0.236	0.135*
ρ_{vk}	-0.236	0.135*
ρ_{ll}	-0.336	0.088
ρ_{lk}	0.336	0.088
ψ	-0.829	0.269

R^2 0.984
R^2 0.980
Log Likelihood 11.27
* Not significant at the 5% level

From this model, we can estimate the returns to density as:

$$\text{RTD} = \left[\frac{\partial \ln \text{C}}{\partial \ln \text{VK}} \right]^{-1} = 0.86 < 1$$

This suggests that there are diseconomies of density i.e. decreasing returns to density. This may occur because the densest networks are the most congested. This could be due to external factors, in particular speed. This variable was tested but was insignificant and reduced the plausibility of the overall model.

We can also estimate the returns to scale as:

$$\text{RTS} = \left[\frac{\partial \ln \text{C}}{\partial \ln \text{VK}} + \frac{\partial \ln \text{C}}{\partial \ln \text{LK}} \right]^{-1} = 0.71 < 1$$

This suggests that there are diseconomies of scale i.e. decreasing returns to scale. This may arise because as firms get larger they become more difficult to manage efficiently and become prone to x-inefficiency.

Our results therefore suggest that, on average, European bus operators produce too many vehicle kilometres and too many line kilometres, but any reduction in vehicle kilometres should be greater than the reduction of line kilometres. However, our results suggest that size is not too important, given the wide confidence intervals around our parameter values both our RTD and RTS estimates are insignificantly different from one. We are unable to reject the hypothesis of constant returns to scale with this model. It should be noted that with a slightly different version of the above model, we omitted line kilometres as a variable and calculated a returns to scale with respect to vehicle kms of 0.33 and with respect to passengers of 0.74. This model again exhibits decreasing returns to scale, particularly where vehicle kms is the output.

We were able to calculate the Allen's partial elasticity of substitution from this model using the following general formulae:

$$\sigma_{ij} = \frac{\gamma_{ij} + S_i S_j}{S_i S_j} \qquad \textit{and} \qquad \sigma_{ii} = \frac{\gamma_{ij} + S_i^{\,2} - S_i}{S_i^{\,2}}$$

Assuming S_l (labour's share of costs) = 0.7, and S_k (capital's share of costs) = 0.3 then the following results are obtained:

$$\sigma_{lk} = \sigma_{kl} = 1$$

$$\sigma_{ll} = -0.490$$

$$\sigma_{kk} = -0.600$$

The own and cross price elasticities of factor demand can then be estimated using the general formula:

$$E_{ij} = \sigma_{ij} S_i$$

This gives the following results:

$$E_{lk} = 0.7, E_{kl} = 0.3, E_{u} = -0.343, E_{kk} = -0.180$$

In contrast to some, but by no means all, of the studies summarised by Berechman (op. cit., Table 5.3), we find relatively strong substitutability between capital and labour. This may reflect different manning arrangements and the use of different sized vehicles. We also find the demand for labour to be relatively inelastic, but greater (in absolute terms) than the findings summarised by Berechman (op. cit., Table 5.4) who found an average elasticity of -0.10. Similarly, we find capital to be relatively inelastic, but in this case our results are similar to the mean of the elasticities studied by Berechman (-0.2).

One other important finding is the dummy variable parameter estimates. These were tested for individual countries and groups of countries. The only dummy variable which had a significant coefficient was that for Great Britain which suggests that, all other things being equal, operating costs for bus systems in Great Britain are 56% below those of the rest of Europe. This seems a large difference until it is noted that operating costs per bus km have decreased by 42% in Great Britain since deregulation.

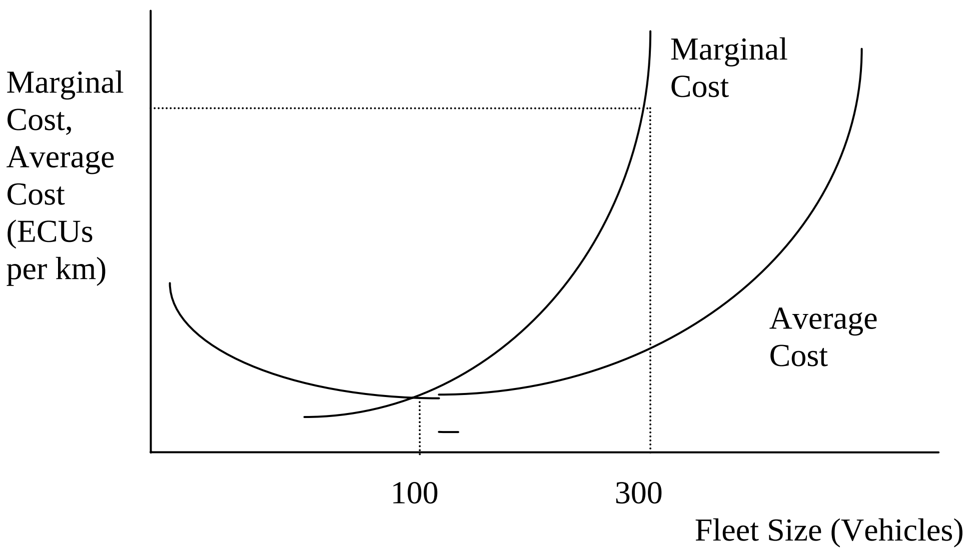
Given the conclusions about data quality made above, it would obviously be dangerous to draw definitive conclusions but there does seem to be a suggestion that cost efficiency reduces with operator size. Our calculations indicate that the mean fleet size in our sample is around 300 vehicles. There is evidence to show that there are only limited economies of scale in the production of passenger transport services by bus. While economies of scale exist at relatively small production scales (up to 50 buses), these seem most often to be exhausted at around 100 buses (see Figure 3.1). This is at the bottom end of the optimal range postulated by Berechman (op. cit.) of between 100 and 500 vehicles. The extent to which such economies of scale can be realised depend on particular local market situations (network size and shape).

Besides this type of economies of scale which are related to production with given inputs, there are other economies related to decreasing input prices with increasing production size (vehicle price, fuel price, etc.). There does not seem to be diseconomies of scale here.

The difference between the first type of economies of scale (production) and the second type (input price) is that the first one requires a bundled production, i.e. production at one place, while the second type of economies of scale can be achieved

even if production is not at one place, i.e. scattered all over a country or even internationally.

Figure 3.1 Bus Average and Marginal Cost



Source: Perez-Perez, 1996, p49.

The above suggests that reforms that fragment the bus industry, such as competitive tendering at a route level, would not necessarily reduce cost efficiency and might promote it. Similarly, restructuring of publicly owned bus companies might be best undertaken in units of 100 vehicles or so (i.e. at the depot level).

The consequences of this production structure is that passenger transport companies tend to evolve towards the formation of large groups of relatively small companies organised as profit centres. This structure can be observed in all countries where competition has been introduced (Sweden, Denmark, France and Great Britain). Such re-agglomerations may also be for a number of reasons that our model has not taken into account:

- Larger companies may be able to lower input prices through the bulk purchase of fuel and vehicles and have access to cheaper finance
- Larger companies can spread fixed costs (e.g. marketing, administration, training) over a greater range of outputs
- Larger companies may, through the long purse hypothesis, be better able to withstand competition and be more able to engage in predation.

None of these features is a technological return to scale but they do reflect economies of scale.

It is useful to reflect on the consistency of our results with those of other studies. Berechman (op. cit.) provides an extremely useful review of transit cost elasticities and he reports on nine applications of translog models including five European examples (DeBorger, Belgium, 1984; Pettreto and Viviani, Italy, 1984; Button and O'Donnell, Great Britain, 1985; Gathon, Europe, 1989; de Rus, Spain, 1989). For the bus industry he finds short run economies of capital stock utilisation, related to excess vehicle capacity, and some evidence of economies of scope. We have been unable to investigate these effects. Berechman also finds evidence of large scale economies of traffic density and constant scale economies, whereas we find mild diseconomies of both density and scale. For bus systems, the cost implications of network size are probably limited, although the demand implications are probably more important but we were unable to measure them. A number of other studies have been undertaken including those of Wunsch, Europe, 1996a; Jorgensen, Pederson, Solvoll, Norway, 1995; Kerstens, France, 1995; Fazioli, Filippinni and Prioni, Italy, 1993; Filipinni, Maggi and Prioni, Switzerland, 1992 and Talvitie and Backstrom, Finland, 1989.

It would have been possible to derive total factor productivity indices in the manner suggested by Talvitie and Sikow, 1992 or Preston, 1997. However, there were concerns that the results would be unduly affected by data quality and it was therefore decided not to undertake analysis of this type.

We have not been able to calibrate cost models with the ISOTOPE and Wunsch rail data sets but we were able to undertake some simple analysis with data collected by Kilburn (1994) for 14 cities in four EU countries. This suggested there were substantial economies of density with the elasticity of costs with respect to train km (holding network km constant) ranging from 0.21 to 0.94. Savage (1995) similarly found increasing returns to density for mass rail transit systems in the US, which confirmed the earlier work of Pozdena and Merewitz (1978) but failed to find diseconomies of density for the largest systems as Viton (1980) had. Savage also found constant returns to scale and suggested that the larger systems could be fragmented without leading to unit cost increases.

3.5 Demand analysis

The aim of this work is to examine the relationship between demand and fare levels, service levels and city size and to see if it is affected by organisational and regulatory factors. The combined Wunsch and ISOTOPE database was again used but due to missing values and outliers, the usable sample size was only 89 observations of which 34 were from Wunsch and 55 were from ISOTOPE. Again the analysis is limited to bus operations and is reported in more detail by Perez-Perez, 1996.

Three model forms were investigated: the linear, the log-linear and the semi-log/negative exponential. It was found that the log-linear model gave the best fit and has the following form:

$$\ln Q = \alpha + \beta \ln F + \gamma \ln VKM + \delta \ln POP$$

where

Q	=	Passengers per annum
F	=	Mean fare per trip (in ECUs)
VKM	=	Vehicle kms per annum
POP	=	Population

The model has the advantage the elasticities are given directly by the parameter values i.e. the fare elasticity is given by β and the service elasticity by γ. A series of statistical tests were undertaken to ensure zero mean of the disturbance, no multicollinearity, homoscedasticity, non autocorrelation, no simultaneity and normality. These hypotheses were accepted with the exception that a White test indicated that the model was affected by heteroscedasticity and hence it was re-estimated using weighted least squares, using as weights the residuals of the original ordinary least squares estimation. It was also found to be appropriate to segment the sample into small cities (population below 500,000) and large cities (population above 500,000). The results in terms of elasticities are given by Table 3.5.1.

Table 3.5.1 suggests an unweighted fare elasticity of -0.42 and a service elasticity of 0.41. This indicates that demand is inelastic and accords well with the work of others (TRRL, 1980, Goodwin, 1992, Berechman, op cit., Table 2.9). Analysis has been taken to see if these values vary by country but they were found to be relatively stable.

TABLE 3.5.1: PRICE AND SERVICE ELASTICITIES
(Standard errors in brackets)

Elasticity	Small City	Large City
Price	-0.50 (0.080	-0.34 (0.064)
Service	0.33 (0.065)	0.49 (0.037)

Our explanation for the difference in the elasticities between small and large cities is as follows. The lower fare elasticity in large cities reflects the greater degree of captivity to public transport due to longer journey distances (making walking less attractive) and greater congestion and parking problems (making car less attractive). This assumes that bus fare charges move in line with other public transport modes. In other words, the fare elasticities in Table 4.11 are conditional on all public transport modes having the same proportionate fare charge - which is probably realistic for most of the cities studied.

By contrast, demand is more service elastic in big cities than small cities, because of the competition from other public transport modes. In this instance, the elasticities in

Table 4.11 may be thought of as ordinary elasticities rather than conditional elasticities. Another factor may be that service (and hence time) is valued more highly in large cities, due to higher income levels. The implied values of service are 0.54 ECUs per bus km in small cities and 1.44 ECUs in large cities.

TABLE 3.5.2: DEMAND MODEL - RESIDUAL ANALYSIS

Country	No of obs	No of Positive Residuals
Belgium	4	1
France	20	4
Germany	6	5
Great Britain	7	3
Italy	5	4
Portugal	11	7
Netherlands	7	3
Norway	7	3
Spain	9	5
Switzerland	6	6
Others*	7	5
Total	89	46

* Austria, Denmark, Finland, Greece, Ireland and Sweden

Analysis of residuals, given by Table 3.5.2 indicate that there may be some systematic variation between countries. The incidence of positive residuals (where actual demand is greater than forecast demand) are recorded. This indicates, all other things being equal, those cities where demand in higher than average. It can be seen that all countries have some good performing cities, with Switzerland and Germany performing particularly well. By contrast, France performs less well. The higher than average levels of demand in Switzerland and Germany may be related to the production pattern based on co-ordinated, clock-faced timetables. This production pattern is also the norm in the Netherlands but in that country competition from the bicycle is intense. Table 3.5.2 does suggest that planned networks may have some advantages in terms of demand. However, it should be noted that our model does not take into account the price, level of service and availability of competing modes, particularly the car. A proxy variable, market share, was tested but was found to be statistically insignificant. The variation in Table 3.5.2 may be partly due to variation in the competitiveness of the car due to fiscal policies, traffic management policies etc.

3.6 Franchising analysis

A number of countries in Europe have experimented with contracting-out, tendering, franchising of bus services. In work so far, we have analysed some of the data on this issue in the ISOTOPE factual database and reviewed the progress and key empirical findings in two areas: Nordic countries and Great Britain.

3.6.1 Results from the ISOTOPE database

Certain sections of the ISOTOPE factual questionnaire namely, sections 2.3.6 and 2.4, asked the respondents questions concerning tendering. These were divided into two sections, directed at operators and authorities respectively. From the answers a series of measures have been developed for both parties and are presented in Table 3.6.1 and Table 3.6.2. Unfortunately, sufficient information was only available in both sections for bus.

In Table 3.6.1 five measures are presented with regard to the operator:

1) the percentage of lines being operated under tender/sub-contract.

2) the percentage of vehicle kms operated under tender/sub-contract.

3) the average number of sub-contracts/tenders held by the operator.

4) the average duration of sub-contracts/tenders held by the operator.

5) the average duration of sub-contracts/tenders held by the operator.

TABLE 3.6.1: SUB-CONTRACT/TENDERING INDICES - BUS (OPERATOR)

COUNTRY	OPERATOR			
	% of lines under sub-contract /tender	% of vehicle kms under sub-contract/ tender	average number of sub-contracts/ tenders	average duration of sub-contracts/ tenders
Benelux	34.6%	30.7%	35	6 yrs
France	20%	6%	5	6 yrs
Germany & Austria	39%	32%	8.3	4.8 yrs
Italy & Greece	27.3%	na	16	4 yrs
Portugal	14%	na	9	1 yr
Nordic	63%	56.4%	2	3 yrs
Spain	30%	9%	2.5	20 yrs
British Isles	na	5.6%	53	3 yrs
Average	32.6%	23.3%	16.35	6 yrs

Source: ISOTOPE database.

The following points can be drawn from Table 3.6.1:-

- Around 33% of the average European bus operators bus lines are operated under sub-contract/tender. The figure is highest for the Nordic countries at around 63% and lowest for Portugal at around 14%.
- The average number of vehicle kmsoperated under tender is around 23%, again the Nordic countries operate most vehicle kms (56.4%), with the least being operated by the British Isles. The figures for France and Spain appear to be low considering

  the percentage of lines under tender, but may indicate an emphasis on network contracts..
- The average number of sub-contracts/tenders operated by each operators is around 16, however, the average number per country ranges from 53 for the British Isles to 2 for the Nordic countries. From the percentage of vehicle kms operated this would suggest that sub-contracts in the British Isles are on a route by route basis, whilst in the Nordic countries they are more on a network basis.
- The average duration of sub-contracts/tenders operated by each operator is around 6 yrs. Contracts are on average highest in Spain at around 20 years and lowest in Portugal at around 1 year.

In Table 3.6.2 a further four measures are presented with regard to Authorities:

1) the percentage of contracts awarded by the authority by type, either full or net subsidy.

2) the average number of bids received per contract tendered, from private and public bus operators.

3) the number of contracts awarded by authority to either private or public firms.

4) Average length of contract awarded in years.

TABLE 3.6.2: TENDERING INDICES - BUS (AUTHORITIES)

COUNTRY	**AUTHORITIES**						
	% of contracts awarded by type		Average No. of bids per contract		No. of contracts awarded		Average contract length
	Full	Net	Private	Public	Private	Public	Yrs
France	65%	35%	3	2	2.4	1.5	9
Nordic	90%	10%	3	1.5	6	3.7	5.2
Spain	100%	-	1.5	0	1	0	14.15
British Isles	20%	80%	2.4	0	421	0	3
Average	69%	42%	2.8	2.0	108	2.6	7.67

Source: ISOTOPE Database.

- On average around 69% of the contractsawarded by authorities to bus operators are full cost contracts, the rest being net subsidy. Spain and the Nordic countries award nearly all their contracts as full costs, 100% and 90% respectively, whilst the British Isles authorities award on average around 80% of their contracts as net subsidy.
- On average each contract attracts around 3 bids from privately owned bus operators and up to 2 bids from publicly owned bus operators. However, neither Spain nor the British Isles attract any bids from the public sector, a reflection of the largely privately owned fleets operating in both countries.

- On average, without Spain and the BritishIsles inclusion, the number of contracts awarded by each authority to operators is around 4.2 to private operators and 2.6 to public operators. From a country perspective it can be seen that the average British authority awards a very high number of contracts each year, and all to private operators.
- The average contract length is around 8 years, with the longest contract length being around 14 years in Spain and the shortest around 3 years in the British Isles.

3.6.2 Nordic Countries

3.6.2.1 Sweden

Jansson (1994B) has reviewed the early stages of comprehensive tendering in Sweden, where tendering has been gradually introduced since July 1989. The progress of tendering was monitored in 25 countries. Initially, around 32% of operations were tendered (February 1990), with this expected to reach 68% in the near future. Cost savings from the initial rounds of tendering varied from 0 to 45%, with an average of around 12%. The composition of the market changed in that municipals' shares declined from 37 to 35% and the state owned companies' (Swebus and Postbus) shares declined from 35 to 31%. The gainers were the independent private firms whose shares increased from 27 to 34%, although their numbers decreased slightly (from 653 to 627). One of the features of tendering in Sweden is the diversity of contract forms concerning payment method, tendering method, responsibility for supervision of operations, vehicles and depots, quality requirements, award criteria, contract length, monitoring and sanctions. Research is ongoing to determine whether contract specification has systematic effects on contract price and quality.

Later work in Sweden has been undertaken by Pyddoke (1996) who notes that the share of tendered bus kilometres has increased from 8% in 1988 to 70% in 1995. During this period costs have decreased by 10% where bus contracts were competitively tendered. Empirical analysis has been undertaken 106 contracts let in 1994. Most contract lengths varied from between 1.5 to 3 years, whilst the majority of the contracts were cost indexed (87%), had penalties for cancellations ((70%) and had age (82%), size (70%) and environmental (74%) requirements. All of the contracts were of a gross cost form or of a cost plus form or both. The findings from the preferrred model were as follows:

- Competition reduces costs. A competition index of the following form was used:
  $CI = \Sigma_i 1/i$
  where i = the number of bids.
  The estimated coefficient implies that moving from one to two bids reduces costs by 12%, moving from one to three bids reduces costs by 17% and moving from one bid to four bids reduces costs by 20%.

- The elasticity of costs per bus km with respect to buses per bus km is -0.12 and with respect to routes per bus km is -0.13. The implies an elasticity of costs with respect to vehicle kms of 1.25 i.e. there are some diseconomies of scale. This result is consistent with that in section 3.4. This is probably an indicator of diseconomies of density. The largest contracts will be in the congested urban areas with correspondingly lower speeds. The fact that costs decrease when the number of buses and, particularly, the number of routes increase may be suggesting the existence of economies of scope.
- Cost per km are 16% lower in sparsely populated areas where speeds will be high and peakiness of demand low.
- Cost plus type contracts appear to be 18% more expensive per km than fixed costs contracts (although this result is not statistically significant).
- Including penalties for late running increases costs by 32% (although this result is not statistically significant).

Jansson (op. cit.) also reviews tendering in Copenhagen where costs reduced by around 10% between 1989 and 1992. A feature of the initial Copenhagen model was that the municipal operator was not allowed to bid. Around 20 bids per contract were attracted compared to the 3 to 5 bids per contract in Sweden. Another important feature of the Copenhagen model is the quality measuring system that has been developed in order to provide operators' financial incentives. This is based on 16 points, 11 related to passenger perception and 5 on objective measurements. Every 3 months, the best operator receives a bonus of 1% of the contract sum.

3.6.2.2 Finland

In Finland, tendering is limited to the Helsinki Metropolitan Area Council (YTV) which is responsible for public transport between Helsinki, Espoo, Vantaa and Kaunianinen. Tendering has cut subsidy costs by 29%, allowed ticket prices to be reduced by 8% and mileage to increase by 3% (YTV, 1996).

Although 23 independent firms participated in the tender rounds, the actual number of firms operating services decreased from 10 to 6, leading to concerns that in the long term concentration will reduce competition and increase costs. This is a concern in a number of Nordic countries.

3.6.2.3 Norway

In Norway the background for introducing competitive tendering to public transportation was different from Denmark and Sweden. Except in the Oslo-region, the private right companies were holding concessions and having the full responsibility for planning, operation, marketing, information, sales, fare box revenue, etc. The county authorities are according to the law, responsible for concessions and approval of fare systems and level, time schedules and subsidies. The relationship between authorities and operators was on a net cost basis. Until 1981 the subsidy was

paid by the state to the operating company. From 1981 to -86 the counties got a lump sum grant for public transport from the state. From 1986 the counties were financed

on a more general basis and free to allocate their funds among the following activities: transportation, secondary education and health care.

From 1986 a system of «normal costs» for bus operation was developed as a basis for the counties to negotiate with their concession holders over subsidy (normal cost - fare box revenue). This emerged as the pressure on budgets became harder. Legal practice had given the concession holders a strong position. It was very rare if anyone lost a concession or went bankrupt. In this period, tendering processes came on the political agenda for supply of a variety of public goods and services. From 1991 the act of transportation introduced competitive tendering and from the spring of 1994 the amendments passed the parliament.

The act of transportation has a clause that gives the operators the right of redemption if more than 20% of their production is put out on tender within 1 year or more than 50% within 5 years from the first tender. This clause is in action until 8 years after the law came into action.

As a consequence the state has cut their transfers to the counties by 140 mill NOK for 1995. This equals an estimated saving of 10% on total cost on 20% of route production. Further cuts came in 1996 (54 mill) and is proposed for 1997 (54 mill).

From 1987 to 1994 total cost per vehicle km of bus operation is reduced by 5% and fare revenue per vehicle km is increased by 9% in real terms (Frøysadal and Hagen 1996). Overall patronage is stabilised at approx. 12 passenger km per vehicle km. The subsidy rate is reduced from 36.5% to 27% over the same period. These figures are national. In Bergen (the second largest city in Norway) the subsidy rate is reduced from 32% in 1990, to 9% in 1995. In Trondheim (the third largest city in Norway) the subsidy rate is reduced from 25% in 1990 to 6.5 in 1995 (Stangeby and Norheim 1995).

In this period and until today we have seen an accelerating tendency toward concentration in the Norwegian bus industry. Mergers due to the redemption clause are rare but buy-outs and co-operation among individual companies through chains is something we have seen weekly over the last two years. The largest group is controlled by the Norwegian State Railways with 1400 buses.

However tendering have not yet become the usual way to establish the contractual relationship between operators and authorities in Norway as expected. An assessment of the tendering process in Oppland county points out some explanations for this (Johansen and Stenstadvold 1996). One reason for this seems to be the companies right to claim redemption if more than 20% of their route production are tendered out in a single year. In a situation with many small companies this makes it difficult for

authorities to find areas that easily can be defined for tender and isolated with respect to users benefit and fare-box revenue without exceeding the 20%.

Another reason might be the tradition with net cost contracts. Due to this the authorities have less information than in the other Scandinavian countries. Obviously competitive tendering is much easier to implement with full cost contracts. For full cost contracts the authorities need more operational information and competence than with the traditional net cost contracts. This implies that more resources have to be used in the responsible public authorities. Their budgets are tightened over the last years and it is thereby hard to buy the competence needed.

In some of the larger cities the subsidies to public transport have declined to near zero over the last few years, due to fare increases and cost reductions. In these areas tendering process could be beneficial from the passenger's view but since subsidy is low, the incitements to test the market by tendering is weak.

Several counties have established agreements with their operators to increase efficiency over a period of 2-5 years. The operators agree to cut costs and subsidy. On the other hand the authority will not use tendering for the specified period.

The only urban area where a small bus network (15-20 buses) is tendered out in Norway so far is Lillehammer in Oppland county. In this case the authority has taken over the responsibility for fare revenue, marketing and information. Adjusted for costs associated with these responsibilities, the cost reduction is estimated to 20%. The service was improved by better buses (low-floor, low emission) and improved information from day 1 (15 November 1995) of the new operator. This led to improved patronage by 30%, increased fare revenue by 20% and in turn increased frequency of the service by 5%. The success depends as much on careful planning and good practice from the county authority, as on the tender itself. (Johansen and Stenstadvold 1996).

3.6.3 Great Britain

The impact of competitive tendering on bus services in Great Britain is reviewed by Mackie and Preston (1996, pp 81-85, 169-172). Two systems of tendering are in place in Great Britain: a system of comprehensive tendering in London and a system of tendering for socially necessary services outside London. Initial tendering in London, reviewed by Glaister and Beesley (1991) indicated that over a five year period costs for tendered routes had decreased by 16% (when administrative and supervisory costs are taken into account), compared to a 20% decrease in London

Buses Limited's (LBL) overall unit costs (which included substantial non tendered service). Glaister and Beesley also found that the use of combination bids had the potential to distant the market. Kennedy (1995) finds that costs had reduced by 25% by 1992, although tendering was only one element of a complex set of policies that

included LBL restructuring and privatisation. Mackie, Preston and Nash (1995) find that by 1994 unit costs in London had come down by 35% and subsidy by 47%, with there being some evidence that privatisation was a major spur to cost reductions.

Kennedy's work was also important in that it found that although contract prices (based on minimum costs) did not vary with the number of bidders, they did vary with the variance of bids, suggesting that, at least in the early stages of the process the winner's curse (or the risk of it) affects bid prices.

Outside London, the situation is more complex because the tendered network has important interactions with the commercial network. Subsidy levels have decreased by 35% but this masks a move from blanket subsidies to subsidies targeted at users. Revenue support has decreased by 60% (Mackie and Preston, op cit., p 161). There is some evidence that it was competition in the tendered market (where independents have a much greater market share than in the commercial market) which acted as the main spur to cost reduction programmes introduced by the major incumbent operators.

Some important work has been undertaken by White and Tough (1993, 1995) that indicates that minimum cost tenders require around 13% less subsidy than minimum subsidy tenders because they attract a greater number of bidders and they find that bid price reduces with the number of bids for minimum cost tenders but not for minimum subsidy tenders. This result differs from that of Kennedy in London but this may be because there is a greater degree of certainty for costs in the Shire counties that White and Tough studies than in London. Mackie and Preston in analysing winning bids in West Yorkshire based on minimum subsidy found that prices did not vary with the number of bidders. They suggest that minimum cost tenders, particularly in areas unaffected by traffic congestion and labour shortages, may have features of an independent value auction in that bid price varies with the number of bidders. In such cases, it is important to sustain a high number of bidders. By contrast, minimum subsidy tenders may have some of the feature of a common value auction in that bid price is not affected by the number of bidders but may be affected by the variance of bids.

Pickup et al. (1991, chapter seven) provide some additional evidence that longer tenders attract lower prices and that vehicle size and age specifications may increase costs by 5 - 10%.

3.6.4 The Netherlands

Tendering has been limited to two experiments in rural areas. Bidders were asked to suggest a better network for the same amount of subsidy as the present operator. In Limburg this resulted in an American company (Vancom) winning with 30% more bus-km for the same subsidy. In Sealand, the incumbent won the contract with 15% more bus-km than the year before. Despite the dominance of a national operator

(VSN - with a 98% market share), five serious bids were received for each tender. This approach may be criticised for being based on a coarse supply oriented set of selection criteria with unclear incentives, but it did illustrate that competition was feasible in the Netherlands (Van de Velde, 1995).

CHAPTER 4

CONCLUSIONS

There is a large number of organisational and regulatory forms in practice in urban public transport in Europe. The key distinctions are between the classic regulated publicly owned monopoly, the deregulated free market and models of limited competition based on competitive tendering and other forms of contract. However, this threefold distinction is a simplification and there are a large number of further sub-divisions, particularly for the limited competition models.

Our theoretical work, based primarily on principal-agent theory, suggests the following. Competitive tendering may be most appropriate for operational functions, may be possible for tactical functions but is not appropriate for strategic functions (section 2.1). Private firms tend to be more effective than public firms in maximising profits because they are better incentivised through shareholder monitoring and bankruptcy and take-over constraints, whilst they are less prone to political interference. Management Employee Buy-Outs tend to be transient phenomenon unless restrictions are made to selling the business on (section 2.2). Competitive tendering based on minimum subsidy and quality incentives should be more efficient than minimum cost methods, but this assumes either perfect knowledge or risk neutrality. Given that firms are likely to possess imperfect knowledge and be risk averse, the determination of the most appropriate contract form becomes an empirical issue (section 2.3). Given various micro-economic features of the urban public transport market, most noticeably user economies of scale and the related concepts of network benefits and intra-marginal demand, there may be arguments for public intervention in terms of finance, if not in terms of planning and operation. Competition may reduce net economic benefit if it merely leads to a duplication of services (section 2.4) or leads to price wars, but can increase welfare where it leads to the development of new products or pricing structures (e.g. Arlanda airport rail link, Manchester Metrolink, moves away from high fares - section 2.5). The overall conclusion is that the private competitive organisation may have advantages in terms of efficiency in production but the public regulated organisation may have advantages in terms of consumption. However, both perfect competition and perfect planning are elusive concepts. In particular, public regulated firms may make inappropriate public choices in terms of investments, prices and output levels due to political intervention. Competitive tendering may provide an appropriate middle ground, particularly for urban services, where user economies of scale are most important. User economies of scale are less important for interurban services where free market solutions may be more appropriate.

In terms of empirical work, our work on partial productivity and other indices for the bus market may be summarised by Table 4.1. Due to data problems and the well known dangers of comparing partial indicators, these results need to be treated with caution. However, in terms of cost recovery it can be seen that deregulated markets have a much better performance (covering 85% of costs) than either markets with limited competition or regulated markets (who both cover 47% and 54% of costs respectively) . In terms of staff productivity, we find productivity in deregulated markets 38% higher than in regulated markets and 5% higher than in limited competition markets. A familiar pattern also emerges when we consider unit costs. Costs in deregulated markets are 36% lower than in markets with limited competition, which in turn have costs 25% lower than regulated markets.

When we consider loads, the pattern is reversed. Regulated markets have mean loads that are around double those of both deregulated and limited competition markets (section 3.1). This again suggests that although deregulated systems may be efficient in terms of production, regulated systems are more efficient (or, at least, more effective) in terms of consumption.

The evidence presented in section 3.1 also suggests that there may be excessive use of rail-based systems, whose average costs per passenger km are around twice those of bus, whilst revenues per passenger km are less than double those of bus. This may reflect an inefficiency in consumption of regulated systems (i.e. excessive consumption of rail services at the expense of bus services).

TABLE 4.1: COMPARISON OF KEY INDICATORS FOR URBAN BUS SERVICES

	R/TC	PK/VK	VK/SN	TC/VK
Deregulated GB	0.85	14.3	20,399	1.44
Limited Comp. DK,FR,FI,NO, SE	0.47	11.9	19,383	2.26
Regulated AT,BE,DE,ES, GR,IT,LU,PT, NL	0.54	25.5	14,776	3.02

Macro-economics considerations related to the Maastricht agreement should put pressure on member states to reduce subsidy levels to urban public transport. There is however no sign of such convergence at present, and some evidence of divergence (i.e. subsidy reductions are greatest in those areas with already low levels of subsidy) (-section 3.2).

An important issue relates to the quality of output. In section 3.3, the three broad organisational forms were assessed in terms of 10 indicators. The results are summarised by Table 4.2. Our results are qualitative but what they suggest is that regulated systems have advantages of affordability but low fares may result in inadequate investments and low levels of supply. By contrast, deregulated regimes may perform well in terms of supply indicators but less well in terms of most other indicators. Models of limited competition may have quality advantages, particularly if contracts include appropriate incentives. These results may though reflect the political context as much as the organisational structure. The opinion surveys seem to confirm the perceived efficiency and effectiveness of limited competition models.

TABLE 4.2: SUMMARY OF QUALITY INDICATORS

	Regulated	Limited Comp.	Deregulated
Supply	-	0	+
Network Design	0/+	0/+	-
Effectiveness	0	0	-
Convenience	0	0	-
Environmental	0	0	-
Speed	0	0	0
Security	0/+	0/+	-
Affordability	+	0	-
Delivery	0	+	0
Customer Opinions	0	+	0

+ = Good Performance - = Poor Performance 0 = Neutral Performance.

Our econometric analysis has been limited by data problems but we have been able to develop a translog cost model, which suggests that the average European bus network exhibits mild diseconomies of both density and scale. From a cost efficiency point of view, operators are producing too many line km and, particularly, too many vehicle kms. The optimal firm size may be around 100 vehicles. It may be sensible, from a cost point of view, to unbundle bus companies into a series of smaller companies based on individual depots. There also appears to be a high degree of substitutability between labour and capital as well as relatively high input price elasticities, particularly for labour. Only operators in Great Britain have costs statistically different from those elsewhere, being some 56% lower (section 3.4).

This evidence is consistent with that presented in Table 4.1 and suggests that the cost difference between Great Britain and the rest of Europe can not be attributed to scale effects and input prices. This work confirms the advantage of deregulated systems in terms of efficiency in production. Work has subsequently been undertaken to examine the causes of the 40% plus reduction in bus costs per km that has occurred in Great Britain since deregulation. Around one third of this cost reduction can be attributed to reductions in the work force. If this redundant labour can not be usefully redeployed , then some 13% of the cost reduction benefits are lost. A further third of this cost reduction is due to reductions in wage rates and fuel prices. To the extent that these are transfers a further 13% of the cost reduction benefit is lost. Thus under some extreme circumstances, it may be argued that only cost reductions of around 13% may be achieved. These are the types of savings being achieved in Scandinavia where redundancies and wage cuts are not the norm.

We have also developed a constant elasticity demand model, which indicates that the average fare elasticity is -0.4 and the service elasticity is 0.4, although there are important differences between small and large cities (section 3.5). The model also indicates that, all other things being equal, demand is greatest in regulated markets, particularly in Germany and Switzerland, although this may also reflect greater control of bus's main competitor, the car. This again suggests the possibility of efficiency in consumption.

Empirical work on tendering (section 3.6) suggests that cost reductions of between 10% and 20% are possible where the industry is not simultaneously restructured, increasing to 35% in London after restructuring (fragmentation and privatisation). Evidence is also beginning to emerge on the effectiveness of different forms of contracts. In particular, it appears that minimum cost contracts may require 13% less subsidy than minimum subsidy contracts in cases where there is plenty of competition for contracts. However, concentration of the industry may be particularly problematic for these type of contracts.

Overall, we find some support for the contention in the Green Paper, the Citizen's Network, that "the concession system - where services are subject to open tender but within a defined operational framework - is well suited to providing an environment which gives incentives to operators to raise standards whilst safeguarding system integration". However, there are a number of different concession/tendering schemes available. Furthermore the main gains of competitive tendering are unlikely to be from increasing efficiency in consumption but from improving productive efficiency. Our work suggests that in some areas unit cost reductions of up to 50% are possible - although reductions of 15% may be more feasible in cases where wage reductions and redundancies are not possible. In order to make such gains, it may be necessary to restructure the bus industry in many member states (principally by fragmenting dominant operators) and to develop anti-trust legislation sufficiently so as to prevent mergers and other practices primarily designed to limit competition.

Finally, it is worth making a number of points that should be addressed by future researchers. Firstly, our work has been affected by a number of data problems that stem from a lack of consistent data on urban transport operations at a European level. There were a large number of comparability issues that the ISOTOPE database, given its limited resources, was unable to overcome. Given the large amounts of taxpayers money that urban public transport receives it would be in the public interest for a consistent set of data to be collected so that assessments of value for money could be made. Any move to comprehensive competitive tendering would require such a database to be constructed.

Secondly, we have outlined at least three forms of competitive tendering that could be applied to urban public transport. We believe that future work should make a more detailed assessment of these three forms and explore the large number of possible variants. The link between organisational and regulatory structure should be also explored in more detail.

Thirdly, in considering the trade-off between efficiency in production and consumption it is clear that the former is more readily measurable than the latter. This may have resulted in an over emphasis on cost cutting at the expense of quality improvements. Consumer surplus (expressed per passenger km) might be considered as a possible summary measure of efficiency in consumption.

Fourthly, some of our simulation work raised important issues. The Arlanda study indicate that further information is need on the extent to which public transport improvements can abstract demand from the car and the extent to which it can generate brand new trips. The Manchester study indicated the need for more detailed data on the variation of network capital and operating costs with both passenger and vehicle kms.

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