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Unconventional funding of urban public transport

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Abstract

In the past decade public authorities have developed a wealth of creative funding mechanisms to support transit systems. This paper offers a taxonomy of various unconventional funding mechanisms (i.e. outside the domain of charges for transit passengers or general taxation schemes), based on a review of financial arrangements for public transport. The paper identifies which classes of funding are particularly successful for the financing of transit systems. This cross-sectional analysis uses a type of artificial intelligence method, viz. rough set analysis. It appears that the nature of the funding scheme and the degree of public acceptability are mainly responsible for the success of unconventional funding mechanisms.

1. Introduction

Urban public transport—defined as publicly provided mass transit systems in cities—is often regarded as a less environmentally damaging mode of transport and in many countries generates much, sometimes uncritical, policy support. As a consequence, deficits in this sector are not charged to the user, but to the taxpayer. The awareness is growing, however, that alternative sources of revenue may be necessary to keep transit systems intact or to finance new investments.

In the past, public transport companies have been supported primarily by federal, state and local funds and revenues from fares. Governments are involved in the financing and operation of this activity, because urban public transportation is an unprofitable business. Many agencies have had to cope with the costs associated with broadening policy goals. At the same time, customer-oriented developments in transit provision continue to demand more financial resources. The labour-intensive nature of the public transit industry, the increasing maintenance needs of the

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older systems and the suburbanisation of jobs and residences have combined to burden many agencies' cost and revenue structures (Transportation Research Board, 1998). This has led to a general awareness of, and concern about, the growing gap between operating expenses and revenues. The need for additional funding is in clear contrast with the recent trend of reduced government financial support for public services, especially in Europe. It is clear that government sources dedicated to public transportation are becoming more and more limited and uncertain. For this reason, authorities (often together with transit operators) are becoming increasingly interested in alternative sources of funding. Innovative funding techniques may include the developing of non-farebox revenue from concessions, adopting private sector methods (e.g. turnkey development), new fare structures, value capture strategies, use of property rights, leasing techniques and hypothecated local taxation.

Of central importance is this latter form of innovative financing, often referred to as earmarked charging (for the economics of earmarking, see Buchanan (1963)). Unconventional, hypothecated taxes or charges is a concept that refers to a large number of local taxes or charges, some or all of whose revenues are directly earmarked to support public transport. The general idea is that revenues gained from some kind of charge are dedicated to finance the operating or investment costs of public transport. This can take various forms. An example in Europe is the French Versement transport scheme, which is a dedicated local employment tax (Farrell, 1999). But there are many other examples.

2. Financial assistance for public transport

2.1. Subsidies

Since virtually all public transport systems operate at a deficit, they obviously need to obtain funds from other urban sources to stay in operation. These funds normally come from federal or local governments. Money provided to cover these deficits is usually called a subsidy. A subsidy is a payment that does not require a direct exchange of goods or services of equal market value in return; it is used to accomplish a specific social objective or has a specific effect (Black, 1995). It is a transfer payment. A subsidy is not normally a gift, and there are strings attached to its use. Various forms of subsidies exist: for example, deficit financing, where an unexpected loss is written off by the controlling authority, and cross-subsidies between different user classes. Cross-subsidies occur when revenues in excess of costs for one group are used to finance deficits incurred for other groups.

2.2. Why subsidies

Many public services collect no revenues because their provision is regarded as necessary. It can also be impractical to put all operations on a fee-for-service basis. Public transport does collect revenue, but it is often regarded as a public service and, hence, is subsidised. Economists have offered several justifications for public transport subsidies (Black, 1995; Gwilliam, 1999).

First, public transport may be a decreasing cost industry. Fixed costs can be large, especially for rail systems, and variable costs relatively small. Urban public transport companies usually operate

at less than capacity. They could carry more riders with little increase in costs, so that the marginal costs for an extra passenger are consequently low. If, therefore, a price is set equal to the marginal cost (this is the economic rule in price setting consistent with the most efficient allocation of resources when only a single price is charged), public transport operators will incur a loss, because the marginal cost is less than the average cost. Price discrimination is possible, but may not be practical. It is clear that funds must be raised from somewhere to keep these operators in business. Financial support is often provided in the form of a subsidy.

Secondly, there is an argument relating to a second-best consideration. As long as road use is not priced according to its appropriate costs, there is an argument for subsidising its substitute. When some people switch from the automobile to public transportation, this reduces air pollution, congestion and noise, which benefits other people who are not users of transit systems.

There are also 'equity' arguments. A widely used argument for subsidising transit is the redistribution of income to certain less privileged groups. It transfers real income in the form of transit service rather than cash. Some groups in society, which are largely dependent on this service, will benefit from this subsidy. Among these target groups are the poor, the disabled and the elderly. Critics often point to the limited effectiveness of this argument, as its effectiveness depends on the extent to which these groups use public transport. It may be argued that the intended redistribution might be accomplished in a less distortionary way.

Subsidies for urban public transport have, therefore, been justified on various grounds. However, some recent research suggests that even when taking account of second-best considerations, current subsidies are excessive and economic efficiency would be served better by decreasing them (Proost and van Dender, 1999). In this paper we are not so much addressing the question of whether public transport should be subsidised, but rather consider the various ways of raising revenues, taking the reality of subsidisation as a given.

3. Unconventional charges and taxes

In most countries, support for public transport has traditionally been financed from general taxation. The federal or local authorities collect the revenues from various taxes, individual and corporate taxes being the biggest sources. In these cases, the funds originate from the same mix of revenue sources as for other services. This means that there is no direct link between the source of revenue and its dedication; there is no hypothecation. The major problem with these forms of financing is that there is considerable competition for funds, and public transport often falls behind spending for other public services such as education and health. This is problematic because of the need for large sums of money, over long periods of time, which in transport tends to be the norm. This has led to a search for new sources of funding, which have included the private sector, via privatisation or contracting agreements, and earmarked charges or taxes.

This second category, the unconventional taxes or charges, refers to a wide number of local taxes and charges, some or all of whose revenue is directly hypothecated to public transport. In recent years, the use of earmarked taxes for local transport demand management has attracted growing attention. This is linked to the trends of seeking additional funding, and of devolving responsibility for local and regional public transport away from national government. This has led to the desire to develop new funding mechanisms.

(i) *Charges for the use of roadspace*: A more traditional reason to implement road charging is to generate revenue, particularly for the construction of new roads. A second and more recent reason is to manage traffic congestion and air pollution. But these revenues could also be used to support public transport. Although road and congestion charging is not widely implemented, there is some experience of revenues being transferred to fund public transport.

Urban toll roads in Europe are very much a Scandinavian phenomenon (Farrell, 1999). Tolling in Bergen, Oslo and Trondheim is based on a cordon system, in which vehicles (public transport exempted) must pay for entry to the city centre, and the revenues are intended to fund a mixture of road and public transport investments. Tolling is also common in the United States, but often related to the use of bridges and tunnels (e.g. Golden Gate bridge tolls subsidise bus and ferry). Congestion charges have been paid in Singapore since 1975 (Small and Gómez-Ibáñez, 1998). The fees collected from the Area License Scheme have helped to improve public transport so as to become a viable substitute for car traffic. A similar scheme has been implemented on a highway (Interstate 15) near San Diego. There, revenues are partly used to finance an express bus service in the I-15 corridor.

(ii) *Consumption taxes*: In general a consumption tax can be described as a tax imposed on consumption goods such as general merchandise, specific services and luxury items or utilities (e.g. gas; see also (vii) below). Consumption taxes can provide a dedicated funding source for a transit agency, and through their implementation, agencies can collect a substantial amount of revenue for operating and capital costs. This kind of taxation seems to be common in the United States where many counties or states have implemented such schemes after obtaining the required voter approval. Two forms of consumption taxes are distinguished: the local sales tax (applied to goods and services) and gambling taxes (a portion of the lottery receipts).

(iii) *Local motoring taxes*: A local motor tax is a tax levied on motorists by local jurisdictions for local purposes (one of them being public transport) and is collected in addition to state and federal motor fuel taxes. Taxing motor vehicles is common all over the world, but revenues are scarcely directly earmarked to fund specific objectives. These motoring taxes can take different forms and are relatively common in the United States, especially the fuel tax and excise tax. Florida, for example, has two types of local motor fuel taxes: a voted gas tax and a local option fuel tax. The voted gas tax allows a 1% per gallon tax to be levied subject to voter approval in a county-wide referendum. The second tax does not require a voter referendum; implementation simply requires a majority vote of a county commission. There are hardly any other examples of such a tax outside the United States, although in Canada some schemes have been implemented (e.g. Vancouver and Montreal).

(iv) *Employer/employee taxes*: While employer and local income taxes are collected by national and local governments in most countries, it is only in a few cities that these are hypothecated to pay for public transport. Using local payroll taxes for public transport happens in the US and in Europe. Oregon has authorised local transit agencies to use a payroll tax to generate revenue, this is done in Portland and Eugene. In Europe, dedicated employment taxes have been used in France, a well-known example being the Versement in Paris.

(v) *Property-related taxes*: As with the employer tax, part of the logic behind the property tax centres around the concept that by providing a public transport service, the occupants of the properties served will benefit (in this case by an increase in the value of the property). This benefit is reflected in an increase in the real property value, which can be regarded as a comprehensive

index of all the benefits generated by the development, including improved accessibility and increased business opportunities. This process of 'value recapturing' can be divided into taxes and the usually one-off or irregular developer levies (see also (vi) below). With this scheme, properties pay regular and continuous amounts to the local or regional government, which then earmarks a specified amount to subsidise public transport. Paying for the provision of public services through the collection of property or land taxes is a fairly common method worldwide, being evident throughout Europe, Asia and North America. But, for the most part, the money is collected by authorities and allocated to each sector according to prevailing political objectives. However, earmarked property taxes to fund public transport are common in North America, in a number of cities, including Minneapolis and New York (Bushell, 1994; Simpson, 1994). Examples of earmarked property taxes outside North America are rare, but can be found in Japan (e.g. Osaka), India (Mumbai) and Spain (Barcelona).

(vi) *Development levies*: Value recapturing is not necessarily restricted to property taxes, as development levies can also be introduced. Various mechanisms can be placed under this heading. They tend to operate within prevailing planning rules, and are consequently often more flexible and individually tailored. Sims and Berry (1999) report that value capture through specific taxes or charges has included development charges, benefit sharing, density bonusing and a connection charge. Quite a lot of these schemes are found in North America, e.g. the Transport Impact Development Fund in San Francisco, the joint development of Bethesda Station in Washington and density bonusing in Portland. In Europe, a development charge scheme can be found in Hamburg, Germany.

(vii) *Parking charges and fines*: Parking charges are a normal fact of life and are used throughout the world by local authorities to fund their activities. As such, they could not be viewed in themselves as an unconventional mechanism. However, such charges are only rarely hypothecated to support public transport or as a part of a planned transport funding package. Clear examples are found in England (Milton Keynes and Heathrow Airport) and North America (e.g. Aspen). Revenues from city-centre parking are also being used in Amsterdam to partly fund a new tramline. A related source of funding is that of parking fines. In France, additional revenues from parking fines and driving offences have been earmarked to pay for public transport infrastructure since 1973.

(viii) *Cross-utility financing*: Cross-utility financing may not strictly be an unconventional mechanism, given its widespread application in parts of Europe, North America and elsewhere. However, it is adopted on a localised basis, and earmarked to fund public transport. Two methods of how cross-utility financing operates in practice can be identified. The first is via a levy on utility use (common in the United States, e.g. in Pullman, in the State of Washington), which operates in a similar way as sales and employer taxes, while the second is a system where a loss-making public transport department is cross-subsidised by a profitable utility department (e.g. Wuppertal, in Germany). Revenues partly depend on external factors, such as economic conditions and social trends.

(ix) *Other unconventional charges*: Two other examples of an earmarked scheme to fund public transportation have been found in our investigation: a student surcharge and a passenger facility charge. The student surcharge on registration fees was implemented after voter approval in Berkeley, California. In the United States, under a law passed several years ago, airports are allowed to charge passenger facility charges. The fee is collected by the airlines in the same way as

other air-related taxes at the time the ticket is sold. There are several hundred airports that collect these facility charges for various projects. While most of these schemes fund airport improvements, a small number involve improving access to the airports, the most notable of which is the new Airtrain light rail linking JFK airport with New York city.

In conclusion, we may state that there is a great diversity in funding mechanisms for public transport. The forms, the sources of funding and the purposes all show a heterogeneous picture. The question is, of course, whether we can identify some specific classes which have proved to be relatively successful.

4. Funding sources: a search for success factors

In the light of the above taxonomic approach, it is now an intriguing research question to find out which determinants of the above-mentioned funding cases are to be regarded as critical success conditions. Clearly, this can be investigated by a systematic comparative analysis of case studies undertaken to raise funds for public transport. The problem here is that the characteristics of the successive case studies are largely qualitative or even nominal in nature, so that standard statistical tools largely fail.

From a methodological perspective, we will deploy here a recently developed approach for comparative case study which originates from multi-criteria analysis and meta-analysis. Such methods have become an established technique for taxonomic purposes in the medical, decision and natural sciences, especially in the case of comparative analysis of (semi-)controlled case study experiments (see, among others, van den Bergh et al. (1997)). At present, these methods are also extensively used in the social sciences, especially in experimental psychology, pedagogy, sociology and, more recently, also in economics (Matarazzo and Nijkamp, 1997). In general, comparative case study analysis aims to synthesise previous research findings or case studies with a view to identifying commonalities which might lend themselves to transferability to other, as yet unexplored cases. Especially in the case of quantitative case study results, there has been a significant methodological progress. In situations of low measurement scales (qualitative, categorical or ordinal data), standard statistical techniques cannot be deployed. In such cases, therefore, in our empirical analysis we have resorted to a recently developed method for qualitative multi-dimensional classification analysis, viz. rough set theory (for details, see Pawlak (1991), Slowinski (1995) and van den Bergh et al. (1997)). It has its origins in the field of artificial intelligence and is able to incorporate not only different measurement scales, but also different degrees of measurement precision known as granularity in classification experiments. This renders rough set analysis very appropriate for our purposes.

The basis of rough set analysis is formed by a categorical data matrix, called the information matrix, in which qualitative information on attributes or performance values of case studies (objects) is systematically represented. The application of rough set analysis to this data table then makes it possible to identify which possible combinations of values of attributes, measured in distinct classes, are compatible with certain ranges of performance variable. The 'decision rules' are then specified as "if... then" statements, based on qualitative information. If certain attributes have a high frequency of occurrence in all decision rules, then this means that they tend to exert a dominant influence on the performance indicator characterising the case study concerned

and hence may be considered to be rather important critical success factors. If an attribute shows up in all decision rules, this is the core of the impact system and may therefore be regarded as the dominant critical success factor.

For a comparative analysis of our case studies on transit systems, we will thus systematically explore and assess the relevant characteristics or attributes which may likely exert an impact on the success of the case study. Hence, we are interested in the identification of critical success factors for funding public transport. In other words, we have to identify several criteria or characteristics that are likely to have an impact on the level or direction of success. We have selected the following 11 characteristic attributes, based on the available data and a sensitivity analysis:

(1) *Approval* (*the attribute that refers to the level of decision making*): In particular, on which level were implementation decisions made (i.e. regional, national or via voter approval).
(2) *Revenues*: What was the amount of the hypothecated revenues raised by the schemes during a given year (i.e. in the bands, <US$10 mln, US$10–20 mln, >US$20 mln).
(3) *Principle*: What is the principle behind the taxation schemes? (i.e. polluter pays, beneficiary pays or someone pays.)
(4) *Public acceptability*: What did the public think about the schemes in terms of acceptance—without any objections or were there (some or many) reservations? (i.e. high, medium or low acceptability.)
(5) *Transferability* (*expressed in terms of easiness of implementation somewhere else*): In particular, does the scheme need many changes, e.g. by law or technology?
(6) *Complexity*: Is there sufficient simplicity for users and administrators in terms of collection of payments? (i.e. very complex, complex, simple, very simple.)
(7) *Flexibility*: Does the case allow for fine tuning of the charge level and the mechanism in general, or is it difficult to implement (e.g. via a change of law)? (i.e. high, medium or low difficulty.)
(8) *Links to transport policy*: To what extent does the taxation scheme affect other modes of transport? (i.e. strong, medium, weak.)
(9) *The level of ambition of the scheme*: How ambitious are the schemes? (i.e. high, medium, low ambition.) A low level of ambition corresponds to a general tax or charge, a part of which is hypothecated; highly ambitious schemes are identified as packages with clear objectives other than funding related.
(10) *The geographical element*: Where is the scheme located? (i.e. Europe, United States, Asia.)
(11) *The type of scheme*: What type of innovative funding? (refers to the nine identified categories (i)–(ix), see Section 3 above.)

The success of a scheme is hence the decision variable—in rough set terms—in our empirical comparison. It is an endogenous variable, to be explained by the characteristics of a particular scheme. The answer to the question of whether or not a case could be characterised as a success was extracted from an extensive literature search and expert opinions on the case studies concerned. Here, we have interpreted success as the achievement of a scheme's objectives. This can differ amongst the various cases, as objectives are not always the same. So, it need not be based on the amount of money generated by the scheme. We have adopted a simple success score on a four-point scale, viz. whether a case has been very successful, moderately successful (some criticism),

Table 1
A classification table for the qualitative measurement of the attributes of public transport funding cases worldwide

Attributes		Qualitative classes for attribute values								
		1	2	3	4	5	6	7	8	9
A1	Approval	Regional	National	Local voter						
A2	Revenues (year)	<US$10 mln	US$10–20 mln	>US$20 mln	Unknown					
A3	Principle	Polluter	Beneficiary	Someone						
A4	Public acceptability	High	Medium	Low	Unknown					
A5	Transferability	High	Medium	Low						
A6	Complexity	Very complex	Complex	Simple	Very simple					
A7	Flexibility	High	Medium	Low						
A8	Linked to transport policy	Strong	Medium	Weak	None					
A9	Ambition	High	Medium	Low						
A10	Geographical location	Europe	United States	Asia						
A11	Scheme	Road user charges	Consumption taxes	Local motor taxes	Employer taxes	Property related	Development levy	Parking charges	Cross-utility	Other charges
Success, described as the achievement of the scheme's its objectives (effectiveness)		Yes	Yes, but some critics	No	Unknown					

not really successful, or of unknown outcome. Cases that have never been implemented belong to this last category.

A success is denoted by the code 1, a moderate success by the code 2, while the code 3 was given when the scheme was not (or hardly) a success, and the code 4 for an unknown result. We will now present the classification table for the codes (see Table 1); the information table on the cases can be found in Table 5 given in Appendix A. [1]

5. Results of the comparative analysis

In this section, we will present and interpret our empirical results obtained by means of rough set analysis. The data of Table 1 and Table 5 have been used as input for the software tool ROSE 2.

[1] This information table draws on data from Oscar Faber (2000).

Table 2
Minimal sets of attributes 1–11 and core attributes

Minimal sets		Core
{1 2 4 6 11}	{1 4 6 8 11}	4: Public acceptability
{2 4 6 7 11}	{4 6 7 8 11}	11: Type of scheme
{2 4 6 10 11}	{4 6 8 10 11}	
{1 4 9 11}	{3 4 9 10 11}	
{4 5 9 10 11}	{4 6 9 10 11}	
{2 4 9 11}	{4 7 9 11}	
{4 8 9 10 11}		

ROSE is a modular software system implementing basic elements of the rough set theory and rule discovery techniques (Predki and Wilk, 1999). It has been created at the Laboratory of Intelligent Decision Support Systems of the Institute of Computing Science in Poznan. The output from the experience consists inter alia of 'minimal sets'. These minimal sets can be described as deterministic conditions, under which certain attributes show up in the performance measure of all cases. Of course, given the combinatorial nature of the rough set methodology, many minimal sets may emerge. Hence, it is of particular interest to identify those attributes that show up in all minimal sets (referred to as the "core"), as attributes in the core may be regarded as critical conditions for the performance of the cases. From our empirical analysis, there appear to be 13 minimal sets (see Table 2). With these sets it is, in principle, possible to explain the success or failure of a certain case. However, this does not mean that for each minimal set, it is always possible to determine a meaningful effect relationship, which can be interpreted on substantive grounds. Nevertheless, these minimal sets are in principle able to identify which combinations of attributes may logically—i.e. in the light of the underlying database—lead to a certain outcome of the success variable.

Table 2 also shows the core of the analysis. Cores are factors that show up in all minimal sets and thus have a common explanatory value in all statements on success conditions. Two factors appear to play a crucial role, viz. public acceptability and type of scheme; these are the core variables. These are thus indispensable in explaining the success rates of the cases involved. Without these, the difference in success of a case cannot be fully explained. The other variables in the minimal sets have a lower frequency of occurrence. When we look at the frequencies of the various attributes, the following picture arises (see Table 3). High frequency rates mean that these attributes stand out in a more pronounced way in the interpretation of the success rate of the public transport funding cases. It is clear that, after the two core variables, in particular, the complexity of the scheme and the level of ambition show up most frequently in the minimal sets (in 54%). It is also noteworthy that transferability and the principle behind the schemes seem to have very little effect.

These results are illuminating, as they show the relative contribution of various background factors of transit subsidy schemes for the performance of these schemes. Moreover, these results are rather plausible and are also frequently mentioned in the literature and in personal interviews.

It is also extremely interesting to present and analyse the decision rules resulting from our rough set analysis (see Table 4). These rules determine the combinations of attributes which are

Table 3
Frequencies of attributes in minimal sets

Independent variable	Appearance in minimal sets
1 Approval	3 (23%)
2 Revenues (year)	4 (30%)
3 Principle	1 (8%)
4 Public acceptability	13 (100%)
5 Transferability	1 (8%)
6 Complexity	7 (54%)
7 Flexibility	3 (23%)
8 Linked to transport policy	4 (30%)
9 Ambition	7 (54%)
10 Geographical location	6 (46%)
11 Scheme	13 (100%)

Table 4
Decision rules for performance of public transport schemes

Rule	Decision variable	Decision rule
1	1	A9 = 2 & A11 = 2
2	1	A4 = 2 & A6 = 5 & A7 = 1
3	1	A11 = 3
4	1	A1 = 2 & A11 = 8
5	1	A2 = 4 & A6 = 2
6	1	A4 = 4 & A10 = 3
7	1	A1 = 3 & A11 = 9
8	2	A11 = 4
9	2	A1 = 3 & A3 = 3 & A4 = 1
10	2	A5 = 1 & A9 = 2 & A10 = 2
11	2	A4 = 3 & A11 = 6
12	2	A11 = 5
13	2	A1 = 1 & A8 = 2
14	2	A9 = 2 & A11 = 8
15	2	A4 = 1 & A11 = 7
16	3	A3 = 1 & A7 = 2 & A9 = 3
17	3	A6 = 4 & A11 = 7
18	4	A2 = 4 & A6 = 1
19	4	A6 = 2 & A10 = 3
20	4	A6 = 2 & A11 = 2

responsible for the level of success. For example, it appears that the highest rate of success (i.e. code 1) can be explained by seven different decision rules. The entries of Table 4 can be interpreted as follows, taking the fourth line as an illustration. If A1 = 2 (i.e. if the approval (attribute 1) of the scheme is national (qualitative class 2)) and if A11 = 8 (i.e. if there is cross-utility financing), then there is a clear case of success. It also appears that local motoring tax schemes (A11 = 3) always have a high rate of success. In the same way, we may derive that funding public transport

by property taxes (A11 = 5) leads to a minor success. Finally, it appears that there are only two rules that explain no success (rule 16 and 17).

6. Concluding remarks

One particularly interesting option for alternative sources of funding local public transportation, elaborated in this paper, involves earmarked charging. Earmarked charges are distinct from general revenues, which can be spent on any legitimate purpose as decided in the annual budget. It appeared that there are various cases where charges or taxes are hypothecated to fund public transport. Most of these categories provide a relatively stable, dedicated funding source with a high level of practicality. For many of the schemes identified, this unconventional funding forms a substantial share of the operating budget. From our overview, it is clear that earmarked taxes have been widely implemented in the United States, since by far the most examples are to be found there. In Europe, relatively few examples have been found. This is mainly due to the institutional organisation in the various countries and the local character of the cases. Local authorities, responsible for the provision of public transport, have a stronger incentive or need to seek new ways of financing public transport. Central governments have more possibilities to make use of existing sources and seem to have less need for new funding techniques.

In general, unconventional mechanisms have evolved because 'traditional ways' of funding public transport have been withdrawn or are viewed as politically problematic. Governments have become sensitive to the levels of general taxation, and funding for public transport is particularly vulnerable to this attitude. This is because persistent expenditure is needed over a period of time and, importantly, the results of such spending are not usually apparent within the lifetime of a single government. A wide variety of schemes is available to fund public transport via hypothecated charging. These schemes are interesting not only as means of raising financial support for public transport systems, but also as a method of sending appropriate pricing signals to transport users with the possibility of their being integrated with more traditional general fiscal and regulatory instruments. However, the majority of existing unconventional measures have evolved without reference to the guiding principles of public finance. Most have been developed simply in order to generate funds to support public transport. A major question then is: How successful have these schemes been?

The rough set analysis provided us with some interesting results. It appeared that the type of scheme and the level of public acceptability have the highest positive impact on the level of success in unconventional public transport funding cases.

In general, the degree of success is not dependent on the transferability and principle behind the schemes (specific target regarding environmental quality achievement (polluter pays) of the transport sector), but on broader considerations such as the convenience, the specific features and the public support of the scheme concerned. The environment plays thus a more indirect role in the adoption of unconventional funding schemes for public transport.

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Appendix A

Table 5
Presentation of the information table

Location of the scheme	Attributes											Decision
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	
Oslo	1	3	1	2	2	2	2	2	2	1	1	2
Trondheim	1	2	1	3	2	2	2	3	3	1	1	3
Bergen	1	2	1	2	2	2	2	3	3	1	1	3
Singapore	2	3	1	4	2	1	2	1	1	3	1	1
San Diego	3	4	1	1	3	2	1	1	2	2	1	1
San Francisco	1	3	1	2	1	4	3	3	2	2	1	2
Hong Kong	2	3	1	3	2	2	2	1	1	3	1	4
Stockholm	2	4	1	3	2	1	2	2	1	1	1	4
Cambridge, UK	1	4	1	4	2	1	1	1	1	1	1	4
Reno	3	2	3	2	3	3	3	4	2	2	2	1
Forth Worth	3	3	3	2	3	3	3	4	2	2	2	1
Atlanta	3	3	3	2	3	3	3	4	2	2	2	1
Austin	3	1	3	2	3	3	3	4	2	2	2	1
Birmingham	1	1	3	4	3	2	3	3	3	2	2	4
Pennsylvania	3	3	3	1	3	3	3	4	3	2	2	2
Arizona	3	2	3	1	3	3	3	4	3	2	2	2
Florida	3	1	1	2	1	4	3	1	3	2	3	1
Washington State	1	3	1	4	1	4	3	1	3	2	3	1
Vienna	1	3	2	4	2	3	2	4	2	1	4	2
Paris	1	3	2	1	2	3	2	4	2	1	4	2
Portland	1	3	2	4	2	3	1	4	2	2	4	2
Vancouver	1	3	2	4	3	3	2	4	3	2	5	2
San Francisco	3	3	2	2	3	3	3	4	3	2	5	2
Los Angeles	1	3	2	1	3	4	1	4	3	2	5	2
Hamburg	1	2	2	4	1	3	1	2	1	1	6	2
San Francisco	1	1	2	3	2	3	3	3	2	1	6	2
Hong Kong	1	3	2	4	2	3	1	4	3	2	6	1
Milton Keynes	1	1	1	2	1	5	1	1	2	1	7	1
London airports	1	1	1	1	1	5	1	1	3	2	7	2
Aspen	3	1	1	2	1	5	2	1	2	1	7	3
La Spezia	1	1	1	2	1	5	1	1	3	1	7	1
Amsterdam	1	1	1	2	1	4	1	1	2	2	7	3
Pullman, Washington	3	1	3	2	2	4	3	4	3	1	8	2
Wuppertal, Germany	2	4	3	1	2	3	1	4	2	2	8	1
Berkely	3	1	3	2	2	4	3	4	2	2	9	1
JFK airport	1	4	1	2	1	3	2	2	2	2	9	2

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