UNDERSTAND AND ESTIMATE THE TRAVEL DEMAND : THE CASE OF ORLYVAL A NEW LINK BETWEEN ORLY AND PARIS

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1. INTRODUCTION

The patronage estimation of a new transport facility is always a key point in the decision process. It becomes of a huge interest when :

- Several projects (...and proposers) are in competition;
- The total cost of the investment is entirely provided by private funds (mainly banks).

It was the case for the traffic prevision of the ORLYVAL system - a 7 km high speed new link - between one of the Paris Airport - Orly - to Antony, where passengers join the RER system to Paris.

These two features increase the patronage assessment complexity because :

- Time for studies is very short, because of competition
- The fare levels are unusual, because of the lack of public support.

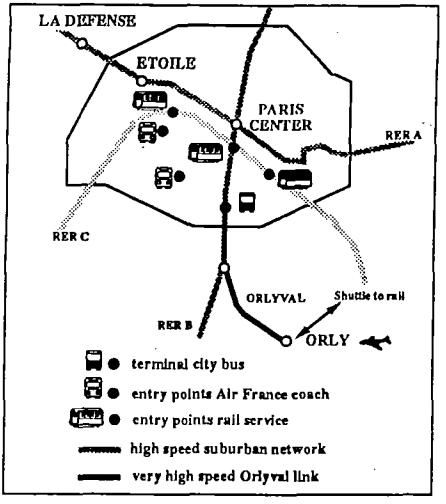
We briefly present :

- The basic data and the main methodological choices.
- The main principles for the in-depth modelling.
- The way we have introduced the new link.

2. BASIC DATA AND BASIC METHODOLOGICAL CHOICES

2.1 Context

The Orly airport comprises 2 platforms, the western for domestic flights and the Southern for international ones. In 1987, the total number of passengers (Arrivals, Departures and Transit) was 18.5 Millions.It was assumed to increase up to 22.2 millions in 1992. The modal split towards Paris and suburbs was 40% by car, 40% by taxi, 20% for transit (3 types of services : Air France coaches ; RATP City buses ; shuttle + railway link). The new ORLYVAL link (an automatic one, designed by MATRA) will be present and clearly apparent on both platforms (no shuttle). Access times are short. The total travel time is guaranteed : 29 minutes to the center of Paris, 42 minutes for the International Business Center of La Défense, to be compared with driving time little shorter off peak but much longer at peaks. The peak headway will be 4 minutes, the off peak one 8, against a 12-15 minutes for buses and coaches. The mean fare will be rather high : 43 F. Francs, against a 22 F.Francs mean for transit and an 50-120 F.Francs interval for taxi, according to the destination in Paris.



1 The links between Orly and Paris

2.2 Basic methodological options

A formal modelling structure is obviously needed to get a numerical estimation of the patronage and revenue. As far as the context is not an academic one, the model must satisfy additional requirements :

- The basic modelling structure must be sufficiently convincing for public authorities and private sector.

- The structure must be opened, that is able to integrate specific assumptions or hypothesis coming from the deciders.

- As a consequence, it must be understood by deciders, in order they form their own judgment.

These constraints lead to reject analogic considerations (for instance comparison with other airports or use of values of time observed in other circumstances) as well as highly complex academic procedures and plead for an econometric type framework.

- Current observations (say, real life) show that the econometric framework has to be enlarged : for example, the whole set of alternatives is not always available for every body, because of situational constraints, habits, or partial levels of information...

This leads to reject agregate models only based on "time versus money" considerations.

These considerations have led us to use disagregate data. Revealed preferences data were available for processing at the beginning of the study, and some type of stated preferences data have been gathered at the end of the process, in order to control conclusions. Our paper will be devoted to the use of disagregate logit models on revealed preferences data. We have choosen them for the following reasons :

- They may be opened to "real life" through dummy variables, mode availability, a.s.o.

- Deciders may judge the quality of the model at an intermediate step, the calibration of the existing situation.

- When accepted, the calibration is a basis from which several ways to introduce the new mode, under several comprehensive assumptions, may be tested.

2.3 The data sets

2.3.1 The supply side

The main market for the Orlyval link has been defined as a set of 96 zones - 20 inside Paris and 76 in the suburbs - where tube or Express Regional Services are available. Separate and direct estimations are provided for the other markets. The model includes 7 modes, of which 6 are available to day and the 7th will be the new link. They are :

- Car, left by the driver at the airport parking. In the tables, it will be referred as mode 1.

- Escort Car. provided by people accompanying the air traveller. Will be referred as mode 2.

- Taxi. Will be referred as mode 3.

- The 3 transit modes : Coach, Bus, and Train, referred as modes 4 to 6.

For each of the 7 modes, for 4 time periods, for 96 zones, have been computed :

- a monetary cost
- an access time
- average and maximum
- waiting and connecting times
- a mean on board time
- a maximum on board time (for each period), considered, for the road network, as an equivalent of the "guaranteed time" provided by rail systems.

2.3.2 The demand side

A sample of 1723 terminal trips from Paris to Orly has been used. Each of them provides :

- The origin zone of the traveller, and the mode he has used
- His socio-economic characteristics : sex, age, professional status, habits of air trips, residential location;
- Some main characteristics of his trip : date, group size, purpose, duration of the absence from home, type of place before trip (home/work/hotel/friends or relatives...).

3. THE CURRENT SITUATION MODELLING

Our aim in this part is to show that, with the same demand data base, the same supply data, and the same formal framework, the quality of the estimation highly depends on the way the specification is conducted through four successive steps.

3.1 Trade-off time/money

The underlying assumptions are as follows :

- Each alternative is available for all the passengers
- Air passengers value in the same way money and time costs
- Time and money are the only determinants of choice.

Under these assumptions, the pseudo R2 is very low and the value of time is very high. The purely econometric framework must be rejected.

	Applies to modes	Value model 1	Value Model 2
VARIABLE			
In véhicle travel time	1 to 6	-0.028	-0.025
Acces time	3 to 6	-0.048	-0.062
Waiting time	4 to 6	-0.21	-0.23
Cost	1 to 6	-0.009	-0.016
Constant (parked)	1	-1.22	-0.14
Constant (escort)	2	-0.75	-0.98
Constant (Coach)	4	1.44	1.15
Constant (Bus)	5	1.17	0.85
Constant (Rail)	6	1.92	1.71
Value of time (/H)		195 FF	96 FF
RHO.2/ZERO		0.132	0.220
RHO.2/CST		0.033	0.049

2. Estimated parameters : Model 1 : Pure trade off time/money
Model 2 : Trade off and car availability

3.2 Trade-off-time/money and availability of modes

We now consider that those of the passengers who do not live in the Paris region have no private car available in the region and so cannot drive by themselves to the airport. "Parking mode" is not available for them. The other assumptions are similar. The pseudo R2 remains very low, but the value of time is more realistic : eliminate an expensive mode (due to parking costs) when it is not available makes the value of time drop.

3.3 Trade-off time/money, availability of modes and separation of populations : better goodness of fit but obvious inconsistency

The sample size does not allow us to divide the population in more than 2 groups. 3 divisions have been tested (domestic/international; way on/way back; Personal/Professional purpose) and the division according to the purpose has provided the best results. The goodness of fit is better and could be acceptable, but inconsistencies related to the value of time are observable : it is higher for personal trips than for professional ones. The model has to be rejected.

	Applies to modes	Personal trips model	Professional trips model
VARIABLE			
In véhicle travel	1 to 6	-0.040	-0.013
Access time	3 to 6	-0.029	-0.107
Waiting time	4 to 6	-0.181	-0.245
Cost	1 to 6	-0.012	-0.013
Constant (Parked)	1	-0.54	0.07
Constant (Escort)	2	-0.22	-1.80
Constant (Coach)	4	1.16	1.40
Constant (Bus)	5	0.83	1.15
Constant (Rail)	6	1.18	2.19
Value of time (/H)		200 FF	60 FF
RHO.2/ZERO		0.196	0.318
RHO.2/CST		0.043	0.043

3. Estimated parameters when separating personal and professional trips

3.4 Step by step estimation using results from a social science approach

As a result of social science studies, some facts may be well established, such as, for example :

- The use of parking strongly decreases with the duration of the trip, in a higher proportion than the increase in parking costs could suggest. Underlying reasons may be that other people in the family may need it, or that parking lots are not considered as sufficiently secure... On the other hand, and whatever the trip is, the use of parking increases with the habit of air travel.

- The use of transit strongly decreases with group size

- The use of transit is higher when the destination point is near one of the terminals, and this is not only explained by travel time considerations

- The use of taxi is the highest when people depart from an hotel and this is related to some agreements between hotels and taxi companies.

All these facts show that the time/money paradigm must be considered as a framework inside which different other processes (information levels, soft organisations, habits, attitudes...) contribute to the modal choice. When integrated to the model through dummy variables, they contribute to a huge increase of the goodness of fit, and results might be accepted. However, when comparing the results of the prevision to the reality for each area, some bias remained, especially in the center of Paris and in some locations in the neighbourhood of the terminals. It is the reason why, in a second step, 2 new dummy variables have been introduced, to take into account :

- a lower car availability in Central Paris, and a higher one in the West Side.

- a notoriousness effect around the terminals.

After these additions, the model has been considered as good, because :

- the pseudo R2 was at one of the highest levels of the litterature,
- the signs of the coefficients of the main dummy variables were corrects,
- the values of time for personal and professional trips seemed correctly estimated,
- coefficients for access, waiting, connecting times were 2 to 8 times higher than for travel times,
- there were no major bias for homogeneous groups of zones.

VARIABLES	PERSONAL TRIPS		PROFESSIONAL TRIPS	
	APPLIES TO MODES	VALUE	APPLIES TO MODES	VALUE
In vehicle travel time	1 to 6	-0.0265	1 to 6	-0.0166
Access time	3 to 6	-0.0545	3 to 6	-0.0563
Waiting time	4 to 6	-0.102	4 to 6	-0.159
Cost	1 to 6	-0.0129	1 to 6	-0.00902
Zonal indexes				
Notoriousness/zone	4 to 6	1.19	4 to 6	1.45
Coach notoriousness/zone	4	1.52	4	1.74
Low car ownership zone	1,2	0.715	1,2	-0.0309
High car ownershipzone	1,2	0,522	1,2	0.792
DUMMY : AIR TRIP				
Way on, short trip	1	2.20	-	-
Way on, long trip	2,3	-0.174	-	-
Personal affairs	1,2	0.0448	-	-
Holidays	2,6	-0.162	-	-
Return within the day	-	-	1	0.426
1 or 2 nights out	-	-	1	0.334
More than 2 nights	-	-	3	0.560
Platform	2	0.127	2	0.747
Winter/summer	2	0.0685	2	0.152
Before 9 A.M.	-	-	1	-0.139
After 8 P.M.	-	-	4 to 6	0.547
Group size = 1	-	-	1	-0.525
Group size > 1	2	-0.0693	-	-
Departure from friends'home	2	0.522	-	-
Departure from hotel	-	-	3	0.996
DUMMY : PASSENGER				
Clerical	2	0.620	-	-
Female	2,3	0.283	2,3	0.534
35-60 years old	3	0.405	1	0.269
Retired	3	0.553	-	-
Paris resident (inner)	3 to 6	0.437	3	0.155
Paris resident (suburbs)	4 to 6	0.306	1	0.449
Other region resident	4,6	0,766	3 to 6	0.676
Student	4 to 6	0.776	-	-
High plane habit (general)	1,3	0.505	3	-0.966
High plane habit (Orly)			2,4 to 6	1.77
Executive			1,3	0.213
Constants				
Parked car		-1.34	1	-0,730
Escort car		-0.26	2	-0,718
Coach		-1.70	4	-3.52
Bus		-0.68	5	-2.46
Train		-0.96	6	-1.87
Value of time		124 FF		111 F
RHO-2/Zero		0.31		0.37
RHO-2/CST		0.13		0.12

4. Estimated parameters, final estimation

4. THE INTRODUCTION OF THE NEW LINK IN THE SYSTEM

As assessed by the well known blue bus/redbus paradox, the introduction of a new mode in equilibrium models is always a difficult task. This should not be considered primarily as a mathematical problem, but as a transport planning marketing investigation, and one of the main questions could be formulated as follows : what are the reasons why, for equivalent times and costs for a given passenger, some systems are more attractive than others ? The answer is not obvious, and must integrate such elements as :

- location of the terminal in the airport : is the mode the first one to be seen in the airport ?
- announcements for the system at the air plane arrival,
- temporal guarantee or dependance on network flow conditions...

Whatever the elements to consider are, the assumptions have to be clear, explicit. Deciders must understand them, share the assumptions or ask to investigate alternative ones.

In the specific case of Orlyval, our main assumptions were as follows

- Orlyval is an additional mode, and we have to model a 7 modes situation,

- Orlyval is a "transit type" mode, even with private management.

All the coefficients of times, costs and dummy are transferred from public modes.

- Due to a good location in the airport and private management, the constant of the utility fonction will be equal to the best of the current transit modes (in a pessimistic option) or a bit higher (in an optimistic one);

- The notoriousness effects, which now applies to transit modes round their terminal, will be effective for Orlyval in larger areas and will be more marked for those who use transit or taxi than for those who use private car to day. On the other hand, they will be reduced to few zones for other transit modes.

- There will be a "screen effect" and each passenger choosing transit will choose among the 2 options which are the best for him.

These options are a compromize between 2 contrasted representations of the future, one where there is a new mode and nothing else, one other where the new mode structures the distribution and consistency of other competing modes.

4 estimations have been provided, considering two constants for the utility function and 2 options for time perception : expected mean time or maximum travel time in case of congestion.

5. MAIN RESULTS

- The four estimations gave a + 20% interval round the central value.

- The market share is highly dependent on the departure zone : from 9% (zone of the coach terminal) to 36% (northern Paris, with high taxi costs and direct Orlyval trips to Orly);

- The system captures 8% from parking users, 17% from escort car and taxi, 36% from transit;

- The sensitivity to all the parameters is rather high :

. fare elasticity : -0,5
. waiting/connecting time elasticity : - 1,0
. car/taxi time cross elasticity : + 0,4
. city buses level of service cross elasticity : + 0,3