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Different route or alternative transport mode?

Modelling shippers' choice when a strategic link is interrupted

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IVT Seminar – Zurich

Evaluate the vulnerability of the road Gotthard corridor via indirect user cost

Firms

Passengers

Ticino

International

Tourism

Business

The logistics of the Ticino firms is strongly dependent on Gotthard corridor since it is the dominant alternative

The longer the distance from the Gotthard corridor the less is the user cost of the firm

A survey has been conducted during the last Easter holidays resulting in a low degree of vulnerability

Business travel represents a minor sector in terms of road flows (train and plane are preferred)

Focus: estimating the generalized cost and implementing a cost benefit analysis tool

- ✓ Telephone survey with six most important freight forwarders aimed to getting initial values for the construction of choice experiment design.

- ✓ Two choice based experiments:

  1. Long run decision (closure of the Gotthard corridor for maximum two consecutive days every month);
  2. Short run decision (closure of the Gotthard corridor for 2 weeks).

- ✓ A total of 27 effective interviews producing 405 cases for model estimation for both experiments (27*15 treatments, per experiments).

- ✓ Descriptive statistics of the attributes:

Variable	Mean	Std.Dev.	Minimum	Maximum
COST	1300	1136.23	122.40	5940.0
TIME	33.35	26.91	1.80	105.6
PUNCTUALITY	97.5	2.29	90.00	100.0

Example of choice card:

Si immagini una situazione dove rischia che il Gottardo sia chiuso UNA VOLTA AL MESE PER UNO/DUE GIORNI. Conferma la strategia attuale o preferirebbe una delle strategie proposte?			
Modalità	Autostrada viaggiante	Trasporto combinato	Modalità Attuale
Costo	Meno 5% del costo attuale	Più 5% del costo attuale	Costo Attuale
Tempo	Più 5% del tempo di viaggio attuale	Più 10% del tempo di viaggio attuale	Tempo Attuale
Puntualità	4% dei trasporti in ritardo	Nessun trasporto in ritardo	Puntualità Attuale

EXPERIMENT ONE: Switching model in actual vulnerable conditions and estimation of status quo parameters.

	Coefficient	t-ratio
ASC_PB	-0.78025	-2.985
PB_BCOST	-0.00490	-5.854
PB_BTIME	-0.08515	-3.061
BPUNT	0.28831	8.025
ASC_TC	-1.04691	-4.106
TC_BCOST	-0.00475	-5.716
TC_BTIME	-0.07634	-2.799
SQ_BCOST	-0.00514	-6.149
SQ_BTIME	-0.06853	-2.511

Number of observations	405
Log likelihood function	-367.02
No coefficients Log-L function	-444.94
Pseudo-R^2	0.175
Pseudo-R^2 adjusted	0.166

	VTTS	VTTS/ton**	WTP_P	WTP_P/ton**
Piggyback	17.37	2.38	58.83	8.07
Combined	16.08	2.21	60.73	8.33
Road (via A2)*	13.33	1.83	56.06	7.69
* status quo alternative				
** average tons loaded (from sample average)				7.3

<u>Note:</u> Allowing for random parameters the fit of the model increases significantly. In particular, the pseudo-R^2 adjusted for the mixed logit model, with panel and with the three cost parameters normally distributed, raises to 0.325. However, the coefficients do not change.

EXPERIMENT TWO: Switching model under unexpected vulnerable conditions.

	Coefficient	t-ratio
ASC_NR	2.47690	3.535
NR_BCOST	-0.00575	-8.643
NR_BTIME	-0.12922	-5.750
BPUNT	0.38409	9.217
BDD_NR	-1.16309	-5.188
ASC_PB	2.06896	2.887
PB_BCOST	-0.00569	-8.504
PB_BTIME	-0.12728	-5.564
BDD_PB	-1.20335	-5.246
ASC_TC	1.52070	2.101
TC_BCOST	-0.00564	-8.387
TC_BTIME	-0.12485	-5.400
BDD_TC	-1.06035	-4.600
SQ_BCOST	-0.00639	-9.137
SQ_BTIME	-0.12151	-5.307

Number of observations	405
Log likelihood function	-405.39
No coefficients Log-L function	-561.45
Pseudo-R^2	0.278
Pseudo-R^2 adjusted	0.269

	VTTS	VTTS/ton**	WTP_P	WTP_P/ton**
New Road	22.48	3.08	66.82	9.17
Piggyback	22.38	3.07	67.55	9.27
Combined	22.15	3.04	68.16	9.35
Road (via A13)*	19.03	2.61	60.15	8.25
* status quo alternative				
** average tons loaded (from sample average)				7.3

“DD” is a firm specific categorical variable and stands for the maximum delivery delay allowed from the client. The less is the max. delivery delay allowed the more is the preference for other alternatives than the status quo.

Getting generalized cost from previous choice modelling:

*GC = cost + VTTS * time + WTPP * (punctuality – 96)*

EXPERIMENT ONE:

	Mkt %	GC
Piggyback	24.2%	2’005
Combined	32.8%	1’951
Road (via A2)	43.0%	1’774

The experiment scenario has been evaluated, from logistics managers, as almost the same as an every day condition and all of them have selected the road (via A2) alternative as status quo. Therefore, the generalized cost for the road alternative can be set as the actual generalized cost.

EXPERIMENT TWO:

	Mkt %	GC
New Road	31.9%	2’632
Piggyback	27.9%	2’621
Combined	26.2%	2’590
Road (via A13)	14.1%	2’371

The generalized cost obtained from estimation results associated with experiment two are used in order to get the ΔGC caused by a 14 days closure of the Gotthard road corridor.

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Cost Benefit Analysis Tool from Discrete Choice Modelling

MODE ATTRIBUTE LEVEL

New Road	Cost	20,00%
	Time	10,00%
	Punctuality	-2,00%
Piggyback	Cost	15,00%
	Time	0,00%
	Punctuality	0,00%
Combined	Cost	5,00%
	Time	10,00%
	Punctuality	0,00%
Road S.B.	Cost	5,00%
	Time	0,00%
	Punctuality	0,00%

RUN MODEL

RESET ATTRIBUTE LEVELS

Return to main screen

Help

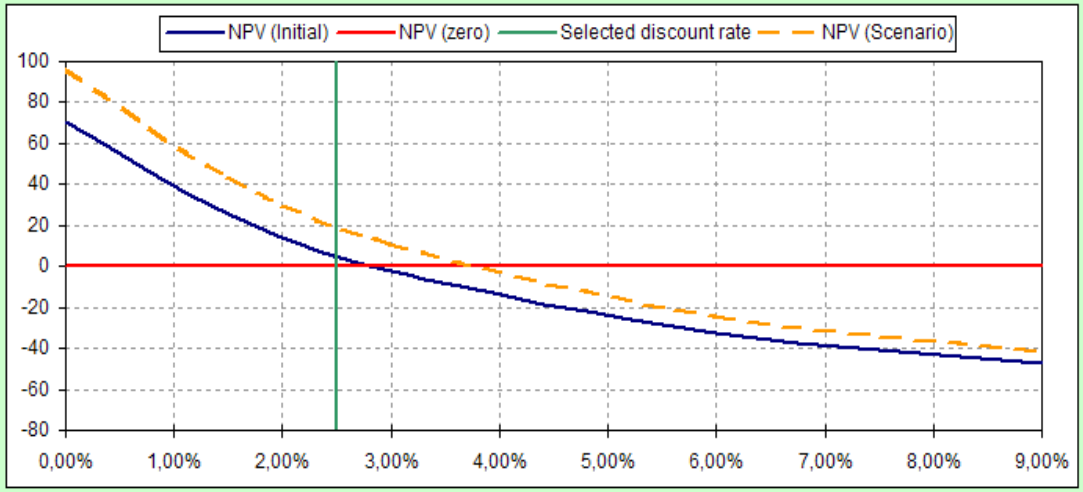
MARKET SHARES

	New Road	Piggyback	Combined	Road S.B
Initial (%)	32%	28%	26%	14%
Initial (N)	2.427	2.126	1.994	1.072
Scenario (%)	11%	28%	36%	26%
Scenario (N)	801	2.117	2.725	1.975
Change (%)	-21,33%	-0,11%	9,59%	11,85%
Change (N)	-1.625	-8	731	903

N 198.078 GC_Ghottard 1.774

GENERALIZED COST (closure of the Ghottard corridor = 14 days)

	New Road	Piggyback	Combined	Road S.B.	
ΔGC (Average)	859	847	816	598	Total ΔGC_I
Initial ΔGC (total)	2.083.422	1.800.917	1.627.547	640.828	6.152.714
ΔGC (Average)	1.155	1.073	978	678	Total ΔGC_S
Scenario ΔGC (Total)	925.431	2.271.398	2.663.853	1.338.472	7.199.154
Change on Average (%)	25,67%	21,02%	16,51%	11,81%	ΔGC_S - ΔGC_I
Change on total (CHF)	-1.157.991	470.481	1.036.306	697.644	1.046.440



COST-BENEFIT ANALYSIS

Initial Cost	80.000.000
Maintenance Cost 1st year	0
Maintenance Cost 2nd year	60.000
Maintenance Cost 3rd year	60.000
Maintenance Cost 4th year	60.000
Maintenance Cost 5th year	60.000
Maintenance Cost 6th to 10th year	60.000
Maintenance Cost 11th to 15th year	60.000
Maintenance Cost 16th to 20th year	60.000
Maintenance Cost 20th to 50th year	60.000
Annual Event Probability	50,00%
Discount Rate	2,50%
Net Present Value (Initial)	**5.609.396**
Net Present Value (Scenario)	**20.449.122**

Cost Benefit Analysis Tool from Discrete Choice Modelling

Help page:

RETURN TO MAIN SCREEN

RETURN TO DSS_closure

RETURN TO DSS_risk

Indicates the initial choice shares used in the model estimation

User inputed value indicating the generalized cost of the status quo alternative

Provides the variation of generalized cost for each of the given mode used in the model estimation

Provides the predicted choice shares under the inputed scenario

Indicates the change in choice shares used in the model estimation

User inputed value indicating the population size

Change the absolute value of attribute level from that currently experienced by each sampled respondent

Provides the variation of generalized cost for each of the given mode under the inputed scenario

Indicate the change in the variation of generalized cost used in the model estimation

User inputed value indicating the initial cost of the selected measure aim to reduce the vulnerability

User inputed value indicating the maintenance cost of the selected measure

User inputed value indicating the annual closure probability

User inputed value indicating the discount rate

MODE	ATTRIBUTE LEVEL	
New Road	Cost	20,00%
	Time	10,00%
	Punctuality	3,00%
Piggyback	Cost	15,00%
	Time	0,00%
	Punctuality	0,00%
Combined	Cost	10,00%
	Time	10,00%
	Punctuality	0,00%
Road S.B.	Cost	20,00%
	Time	5,00%
	Punctuality	0,00%

RUN MODEL

RESET ATTRIBUTE LEVELS

Return to main screen

Help

MARKET SHARES

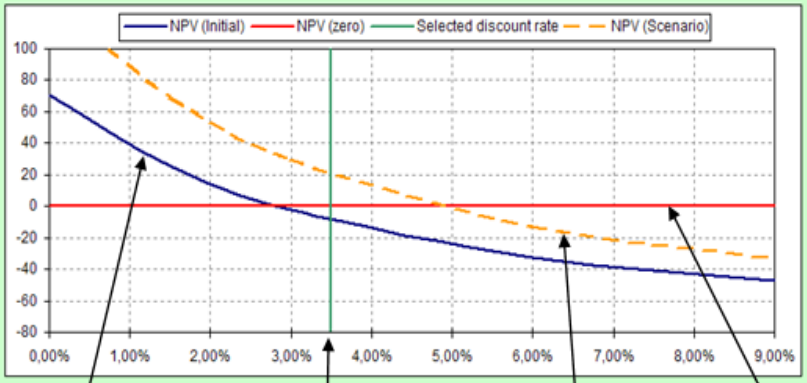
	New Road	Piggyback	Combined	Road S.B
Initial (%)	32%	28%	26%	14%
Initial (N)	2.427	2.126	1.994	1.072
Scenario (%)	29%	32%	30%	9%
Scenario (N)	2.242	2.403	2.251	723
Change (%)	-2,43%	3,64%	3,37%	-4,59%
Change (N)	-185	278	257	-350

N 198.078

GC_Ghottard 1774

GENERALIZED COST (closure of the Ghottard corridor = 14 days)

	New Road	Piggyback	Combined	Road S.B.	
ΔGC (Average)	858	847	816	597	Total ΔGC_I
Initial ΔGC (total)	2.082.539	1.800.143	1.626.822	640.438	6.149.941
ΔGC (Average)	1.352	1.072	1.053	934	Total ΔGC_S
Scenario ΔGC (Total)	3.030.428	2.577.097	2.370.128	674.643	8.652.296
Change on Average (%)	36,51%	21,03%	22,52%	36,03%	$\Delta GC_S - \Delta GC_I$
Change on total (CHF)	947.889	776.954	743.306	34.205	2.502.355



COST-BENEFIT ANALYSIS

Initial Cost	80.000.000
Maintenance Cost 1st year	0
Maintenance Cost 2nd year	60.000
Maintenance Cost 3rd year	60.000
Maintenance Cost 4th year	60.000
Maintenance Cost 5th year	60.000
Maintenance Cost 6th to 10th year	60.000
Maintenance Cost 11th to 15th year	60.000
Maintenance Cost 16th to 20th year	60.000
Maintenance Cost 20th to 50th year	60.000
Annual Event Probability	50,00%
Discount Rate	3,50%
Net Present Value (Initial)	**-9.224.031**
Net Present Value (Scenario)	**20.123.106**

NPV at different discount rates according with default values

Highlight the selected discount rate

NPV at different discount rates according with scenario values

Highlight the zero-threshold of NPV

Indicates the NPV according with scenario values

Indicates the NPV according with default values

Note:
In blue free user inputed values
In black estimation results

Conclusions

- Two experiments reflecting two kinds of vulnerability give similar results with interesting differences (e.g. VOT)
- No nested structure is found
- Mixed logit improves the efficiency of the estimation without changing the values of the parameters significantly
- Freight transport user cost of link closure is significant while passenger transport is not very vulnerable in terms of user cost
- With a low discount rate of 0.025 and a high event probability of 0.5 and a lifetime of 50 years an investment in a gallery of CHF 80 million results in a positive net present value, while one of CHF 120 million would not be a good investment.