

Demand module and elasticities

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What is TREMOVE

- Simulation model
- for the transport sector
- to predict effects of policies
- ... on emissions
- ... on overall welfare

- Public : www.tremove.org

Objective 1 : baseline

Transport and Emissions Baseline (2030)

- Transport activity
 - Vehicle stock turnover
 - Emissions & Energy consumption
- *Consistency with other European models (SCENES/TRANSTOOLS, PRIMES/POLES , RAINS)*
 - *Preference for EU data sources – refinements with national data (EUROSTAT, COPERT, ARTEMIS)*
 - *Stakeholder consultation and agreement*

Objective 2 : simulations

Analysis of possible policy measures

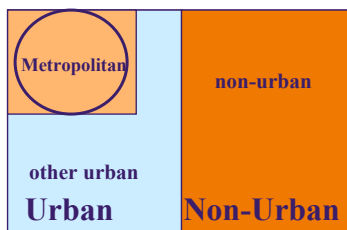
- Technology
- Emission standards
- Energy efficiency
- Road Charging - Marginal cost pricing
- Public transport subsidies
- Overall transport policy (e.g. White Paper)
- ...

Effects on transport flows, fleets, emissions, welfare

Scope : Regions

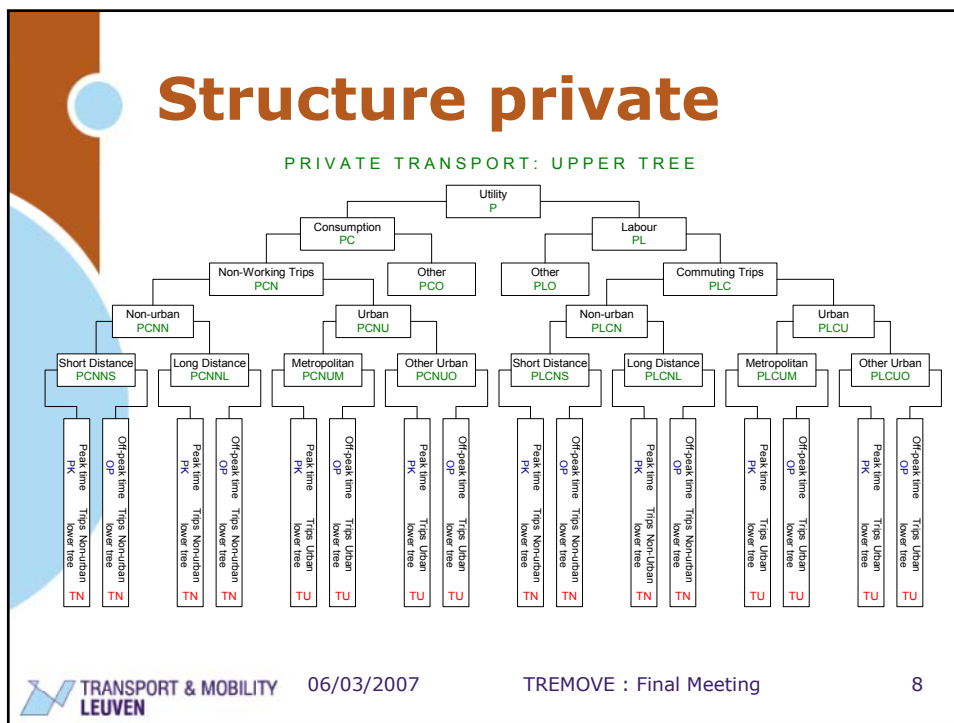
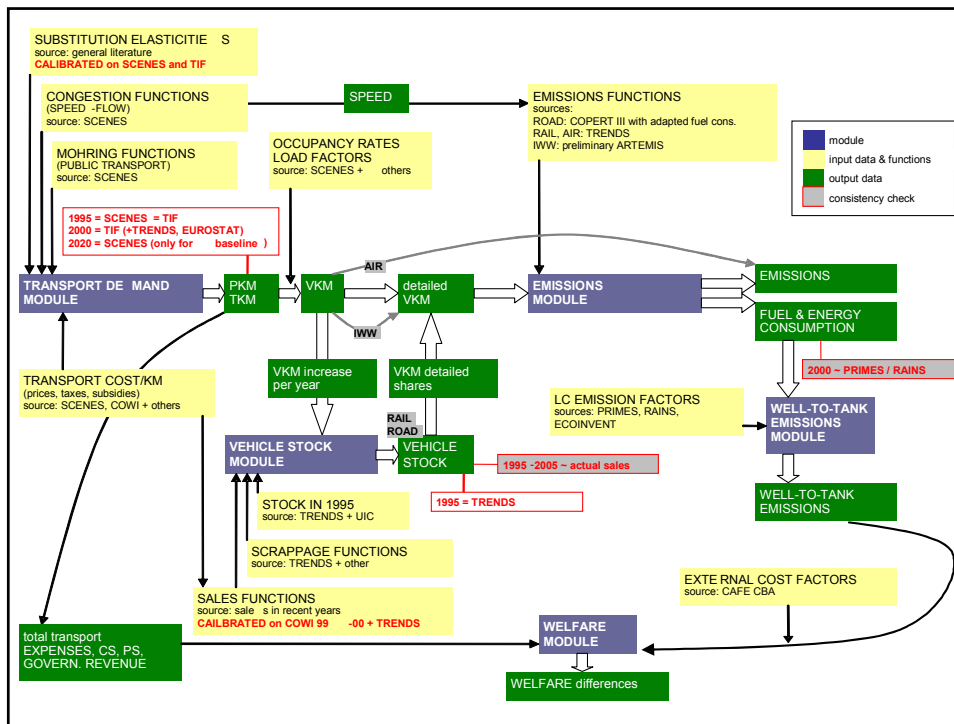
1 Maritime model – 8 Sea regions

31 Country models – 3 Regions per country



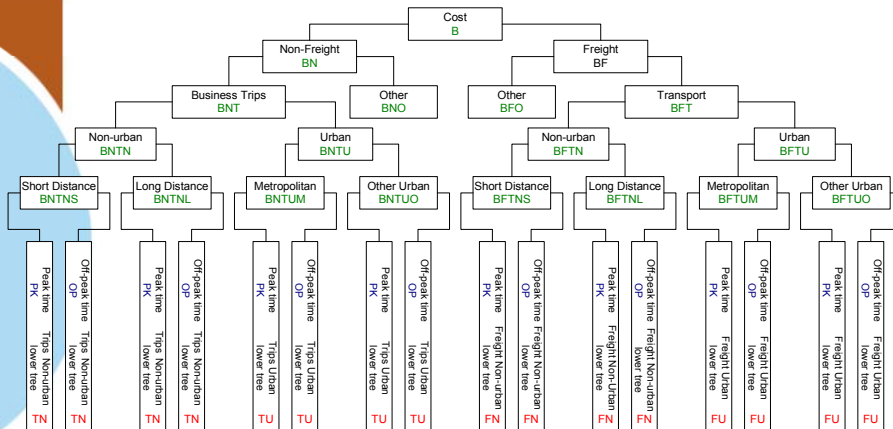
Scope : Modes

Vehicle category	Vehicle types
Car	10
Moped	1
Motorcycle	4
Van (passenger N1)	2
Light duty truck (freight N1)	2
Heavy duty truck <7.5 ton	1
Heavy duty truck 7.5 - 16 ton	1
Heavy duty truck 16 - 32 ton	1
Heavy duty truck > 32 ton	1
Bus	2
Metro/Tram	1
Passenger train	5
Freight train	4
Inland ship	21
Plane	5 (distance classes)



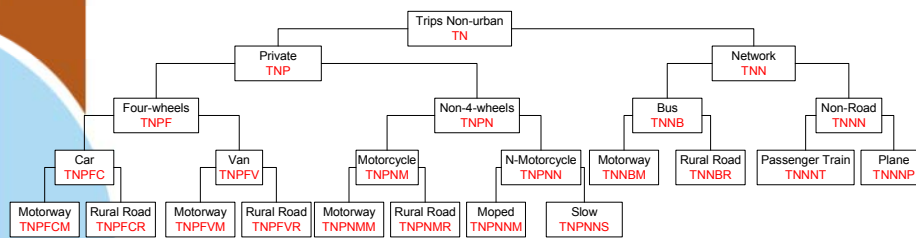
Structure business

UPPER TREE: BUSINESS



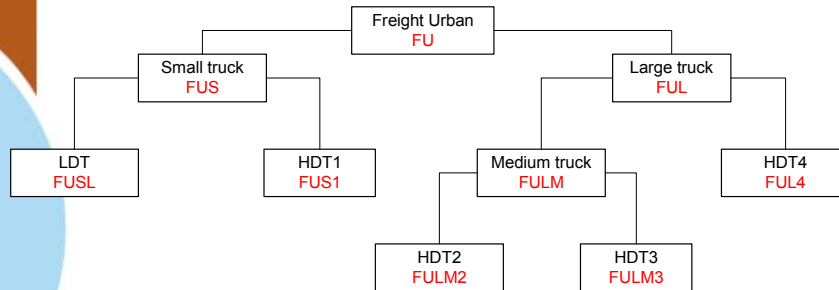
Non-urban passengers

LOWER TREE: TRIPS NON-URBAN



Urban freight

LOWER TREE: FREIGHT URBAN



Economic concept

- Quantity q_j of good j consumed by a given consumer.
- Quantity of j is decreases by Δq_j .
- Keep the consumer's utility constant => consumption q_i of good i , must decrease by $-\Delta q_i$.
- Thus the marginal rate of substitution between good i and good j is given by: $-\Delta q_i / \Delta q_j$

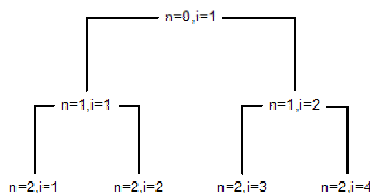
Economic concept

- Elasticity of substitution

$$\sigma = -d \ln(q_i/q_j) / d \ln(dq_i/dq_j)$$
- Substitution and income effects
 changes in prices, if a good i (for instance, car transport) becomes cheaper,
- *substitution effect*: consumers buy more of good i and less of good j
- *income effect*: consumers tend to consume more of all goods, including those whose price has not changed

Economic concept

- Nested utility functions



- The term *association* visually means there is a vertical link between elements:
 - (2,1) is associated with (1,1)
 - (2,1) is associated with (0,1)
 - (2,1) is *not* associated with (2,4)

Economic concept

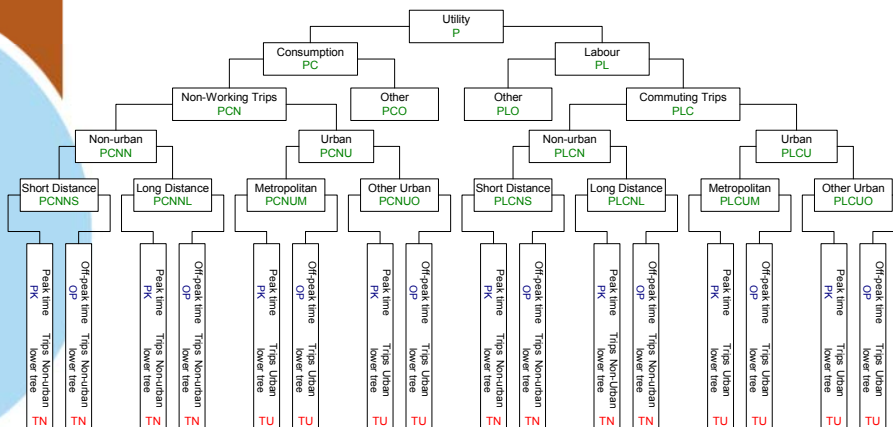
- Quantity is function of:
 - Elasticities of substitution
 - Keller alpha
 - Quantity of all other goods

$$q_{n,i} = \left[\sum_{j \in i} \alpha_{n+1,j}^{1/\sigma_{n,i}} q_{n+1,j}^{\sigma_{n,i}/(\sigma_{n,i}-1)} \right]^{\sigma_{n,i}/(\sigma_{n,i}-1)}$$

- CES-type utility function

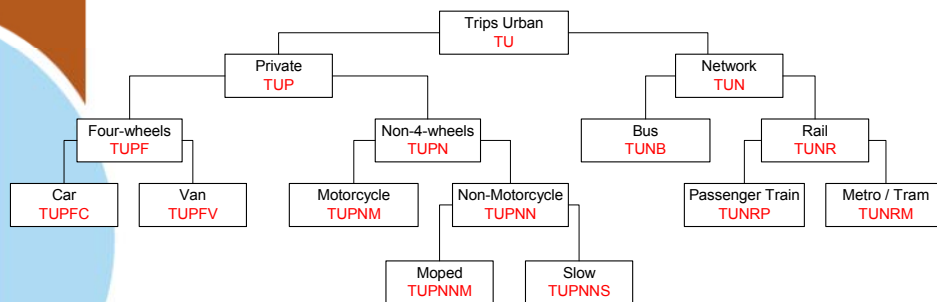
Structure private

PRIVATE TRANSPORT: UPPER TREE



Urban passengers

LOWER TREE: TRIPS URBAN

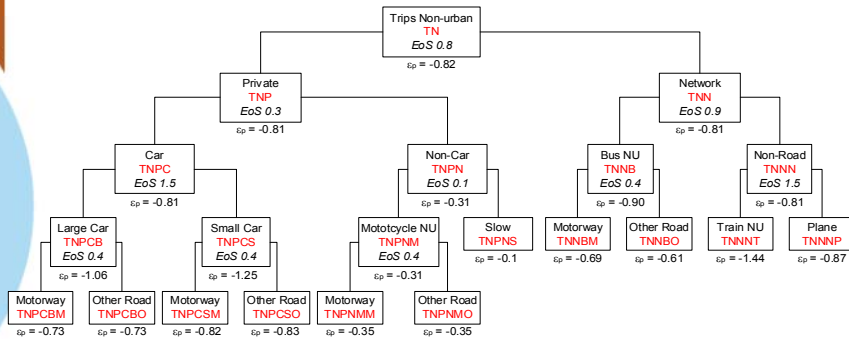


Calibration

- Input
 - Quantities
 - Prices
 - Elasticities of substitution
- Output
 - Keller alpha's
 - => Calibrated CES model
- Output
 - Price elasticities

Result

PCNNL (Non-working, Non-urban, Long distance Trips) PK (Peak time)
Elasticities of Substitution (EoS) and calculated General Price Elasticities (ϵ_p)



Some cross elasticities

$E_{TNPCB, TNPCS} = 0.25$
 $E_{TNPCS, TNPCB} = 0.44$
 $E_{TNNNP, TNNNT} = 0.06$
 $E_{TNNNT, TNNNP} = 0.63$
 $E_{TNN, TNP} = -0.015$
 $E_{TNP, TNN} = -0.007$
 $E_{TNNNT, TNPCBM} = -0.005$
 $E_{TNPCBM, TNNNT} = -0.001$

Some monetary price elasticities

$E_{TNPCBM} = -0.27$
 $E_{TNPCBO} = -0.28$
 $E_{TNNNP} = -0.83$
 $E_{TNNNT} = -0.83$

Some fuel price elasticities

$E_{TNPCBM} = -0.09$
 $E_{TNPCBO} = -0.09$
 $E_{TNPCSM} = -0.08$
 $E_{TNPCSO} = -0.08$

TREMOVE price elasticities: freight

	LDT urban trips	HDT4 urban trips	LDT long distance non-urban on motorway for cargo	HDT4 long distance non-urban trips on motorway for cargo	Train long distance non-urban trips for cargo	IWW long distance non-urban trips for cargo
PL	-0.86	-0.10	-0.16	-0.17	-0.56	-0.30
AT	-0.26	-0.10	-0.79	-0.65	-0.60	-0.31
BE	-0.56	-0.73	-0.57	-0.70	-0.52	-0.33
CH	-0.27	-0.48	-0.85	-0.69	-0.60	-0.30
CZ	-0.81	-0.10	-0.39	-0.38	-0.55	-0.31
DE	-0.64	-0.10	-0.81	-0.80	-0.50	-0.34
DK	-0.52	-0.10	-0.81	-0.79	-0.53	
ES	-0.94	-0.10	-0.39	-0.51	-0.51	
FI	-0.85	-0.10	-0.25	-0.24	-0.54	
FR	-0.92	-0.10	-0.50	-0.74	-0.54	-0.31
GR	-0.79	-0.10	-0.44	-0.55	-0.51	
HU	-0.76	-0.10	-0.43	-0.48	-0.58	-0.32
IE	-0.55	-0.10	-0.13	-0.15	-0.51	
IT	-0.68	-0.19	-0.78	-0.82	-0.52	
LU			-0.34	-0.39	-0.57	-0.31
NL	-0.12	-0.10	-0.90	-0.77	-0.41	-0.47
NO	-0.90	-0.10	-0.36	-0.41	-0.52	
PT	-0.72	-0.10	-0.52	-0.47	-0.52	
SE	-0.90	-0.10	-0.36	-0.41	-0.55	
SI			-0.66	-0.62	-0.55	
UK	-0.80	-0.49	-0.44	-0.44	-0.51	

TREMOVE price elasticities: business

	Train non-urban trips	Plane non-urban trips	Car non-urban trips long distance on motorway
PL	-1.47	-0.98	-0.15
AT	-1.43	-0.98	-0.49
BE	-1.43	-1.03	-0.57
CH	-1.05	-1.33	-0.47
CZ	-1.47	-0.99	-0.19
DE	-1.36	-1.02	-0.73
DK	-1.40	-0.98	-0.79
ES	-1.49	-1.00	-0.28
FI	-1.46	-0.95	-0.26
FR	-1.11	-1.33	-0.61
GR	-1.50	-0.98	-0.34
HU	-1.48	-0.98	-0.24
IE	-1.50	-0.96	-0.12
IT	-1.43	-0.95	-0.59
LU	-1.47	-1.01	-0.40
NL	-1.45	-0.95	-0.66
NO	-1.39	-1.03	-0.22
PT	-1.50	-0.96	-0.29
SE	-1.40	-1.00	-0.23
SI	-1.40	-0.99	-0.22
UK	-1.45	-1.03	-0.41

TREMOVE price elasticities: passenger

	Bus urban trips	Train urban trips	Metro/tram urban trips	Car urban trips	Train non-urban trips	Plane non-urban trips	Bus non-urban trips long distance on motorway	Car non-urban trips long distance on motorway
PL	-0.40	-1.04		-1.68	-1.38	-1.02	-0.41	-0.15
AT	-0.32	-0.90	-0.51	-1.59	-1.43	-0.97	-0.69	-0.48
BE	-0.67	-1.14	-0.34	-1.19	-1.47	-1.01	-0.74	-0.55
CH	-0.39	-1.61	-0.35	-1.01	-1.43	-1.02	-0.69	-0.40
CZ	-0.40	-1.27		-1.50	-1.40	-1.01	-0.53	-0.24
DE	-0.52	-1.17	-0.50	-1.15	-1.49	-0.96	-0.80	-0.62
DK	-1.03	-1.15		-1.08	-1.50	-0.98	-0.71	-0.70
ES	-0.96	-0.78	-0.50	-1.11	-1.48	-0.95	-0.69	-0.28
FI	-0.98		-1.23	-1.04	-1.34	-1.07	-0.64	-0.23
FR	-0.38	-0.93	-0.78	-1.25	-1.29	-1.14	-0.86	-0.50
GR	-1.87			-1.08	-1.50	-0.97	-0.49	-0.30
HU	-1.55			-1.36	-1.24	-1.14	-0.54	-0.23
IE	-1.88			-1.07	-1.50	-0.92	-0.46	-0.12
IT	-0.45	-1.35	-0.45	-1.10	-1.45	-0.96	-0.80	-0.53
LU	-1.94			-1.02	-1.49	-0.97	-0.79	-0.45
NL	-0.37	-1.48	-0.36	-1.15	-1.48	-0.99	-0.74	-0.63
NO	-1.43	-0.82		-1.01	-1.48	-0.98	-0.57	-0.24
PT	-1.92			-1.04	-1.49	-0.93	-0.72	-0.28
SE	-0.54	-1.10	-0.51	-1.19	-1.49	-0.99	-0.57	-0.24
SI	-0.35	-1.36		-1.42	-1.00	-1.33	-0.72	-0.25
UK	-0.67	-1.01	-0.57	-1.10	-1.46	-1.02	-0.61	-0.40