9. Demand (large-freight, tkm)

Overview

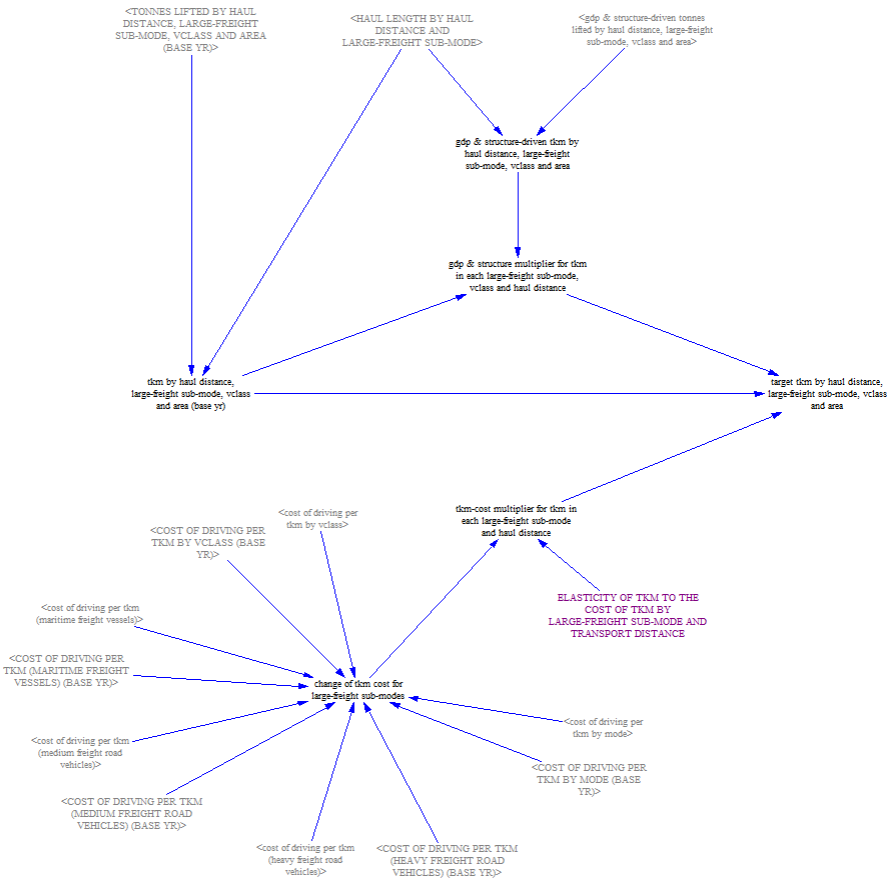
Target

The target of the view is to consider the influence of the cost of driving on the large-freight activity projections over time. The view "demand (large-freight, gdp & structure)" projects the tkm on the basis of the evolution of the GDP and the structure of the large-freight system. This view adds the effect caused by the variations on the cost of driving through elasticities applied to the output on tkm from "demand (large-freight, gdp & structure)".

Structure

The top of the view calculates a multiplier that describes the evolution of the large-freight activity due to changes of the GDP and the large-freight structure. The calculations performed at the bottom estimate the multiplier that takes into account the variations of the cost of driving. Figure 9.1 shows both multipliers affecting the base year value in order to get the final target tkm over time.

Figure 9.1 Large-freight demand, target tkm



Detailed description of the view

Inputs

The target tkm affected by changes in the cost of driving needs to be disaggregated by haul distance, large-freight sub-mode, vehicle class and area. This is consistent with the disaggregation used elsewhere in the model. Contrary to the case of the "demand (large-freight, gdp & strucutre)" view, no further disaggregation is needed here. Since the tkm under the influence of the GDP and the large-freight structure were not determined at this level of aggregation, several inputs from "demand (large-freight, gdp & strucutre)" are brought to this view to perform such calculation. In particular, this concerns the tonnes lifted at the base year and over time, as well as user inputs on the haul length.

A number of endogenous cost inputs refer to the cost of driving per tkm and enable to figure out the changes on cost compared to the base year value. All these inputs come from the view "cost of driving" and are specific for each of the large-freight sub-modes. An increase of the cost of driving provokes a reduction in the activity, while a sub-mode that becomes more economic is more likely to be used.

The elasticities by large-freight sub-mode and transport distance are exogenous inputs (entered in the "Demand generation parameters" sheet of the ForFITS Excel file). The default data entered in the ForFITS Excel file take into consideration fixed cost elasticity parameters (i.e. not dependent on GDP per capita or other context-specific variables). These parameters are differentiated by large-freight sub-mode (medium duty trucks, heavy duty trucks, rail, air, pipelines, inland water transport, short-sea shipping, and maritime transport) and by distance class (short, medium, large and very large to represent, respectively, local, national, international and intercontinental transport).

The basis for the default assumptions includes literature sources (Mitchell, 2010 for road freight maritime transport elasticity; Litman, 2011 for road and rail; Jourquin et. al., 1999; and De Jong et. al., 2010 for road freight demand elasticity). A common finding of the literature sources is that freight elasticities are very variable. The sources themselves indicate different reference values, depending on market conditions and other constraints. For this reason, the definition of the cost elasticity parameters requires a good deal of assumptions and expert judgment. The following considerations summarising literature as well as expert judgment, have been used for the definition of the default parameters:

a) road freight is relatively inelastic;
b) on average, rail freight is at least as elastic as road freight and probably more elastic;
c) on average, inland navigation and maritime are more elastic than rail;
d) road freight has very poor or no substitutes on short distance: for local transport, road freight elasticity is very low;
e) rail freight and inland navigation are used on short distances only in particular cases for bulk goods (e.g. crude building material by inland navigation or scrapped metals by rail) for which there are limited alternatives: their elasticity is therefore low;
f) maritime and air freight are not used on local distance;
g) road freight and rail freight are only marginally used for intercontinental transport, where maritime is generally an attractive alternative: for this reason, their elasticity is high;

h) inland navigation is not used for intercontinental transport;
i) air freight is used for specific goods for which transport time is critical, therefore it is difficult to replace. Therefore, despite literature does not suggest values, it can be assumed that its elasticity is low;
j) pipeline transport is not sensitive to transport costs.

Outputs

The GDP- and structure-driven freight activity (expressed in tkm), both at the base year and over time, is calculated as the product of tonnes lifted and haul length.

$$freight\ activity\ (tkm) = tonnes\ lifted\ (tonnes) \times haul\ length(km)$$

The tonnes lifted are characterized by haul distance, large-freight sub-mode, vehicle class and area; the haul distance is differentiated by haul distance and large-freight sub-mode. The comparison of the product over time and at the base year provides a factor (multiplier) that identifies the evolution of the activity caused by the development of the GDP and the structure of the large-freight transport system.

$$GDP\ \&\ structure\ multiplier = \frac{tkm\ at\ the\ base\ year}{gdp\ \&\ structure - driven\ tkm\ over\ time}$$

The variable "change of tkm cost for large-freight sub-modes" calculates the percentage change of the cost of driving over time (with respect to the base year) for each large-freight sub-mode.

$$Change\ of\ tkm\ cost\ for\ each\ large\ freight\ sub-mode = \\ = \frac{Cost\ of\ driving\ per\ tkm\ (over\ time)_{sub-mode\ i} - Cost\ of\ driving\ per\ tkm\ (base\ year)_{sub-mode\ i}}{Cost\ of\ driving\ per\ tkm\ (base\ year)_{sub-mode\ i}}$$

According to the definition of elasticity (ratio between the percent change of tkm and the percent change of the cost of driving), the multiplier to be applied to the initial tkm at the base year reflecting the impact due to variations on cost of driving is calculated as follows:

$$Cost\ multiplier = 1 + \%\ change\ of\ cost\ of\ driving \times Elasticity\ of\ tkm\ to\ cost\ of\ driving$$

Finally, the target tkm is calculated as the addition of both the effects (GDP & structure and cost of driving), considering them as independent from each other.

$$target\ tkm = tkm\ at\ the\ base\ year \times\ GDP\ \&\ structure\ multiplier \times Cost\ multiplier$$

References

De Jong G., Schroten A., Van Hessen H., Otten M., Bucci P. (2010), *Price sensitivity of European road freight transport – towards a better understanding of existing results*, http://www.transportenvironment.org/sites/te/files/media/2010_07_price_sensitivity_road_freight_significance_ce.pdf

Jourquin B., Beuthe M., and Koul à Njang' Hai C. (1999), *Intermodality and substitution of modes for freight transportation: computation of price-elasticities through a geographic multimodal transportation network analysis*, http://www-sre.wu-wien.ac.at/ersa/ersaconfs/ersa99/Papers/A359.pdf

Litman T. (2011), *Transportation elasticities. How prices and other factors affect travel behavior*, http://www.vtpi.org/tdm/tdm11.htm

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