10. Demand (light road freight veh shares)

Overview

Target

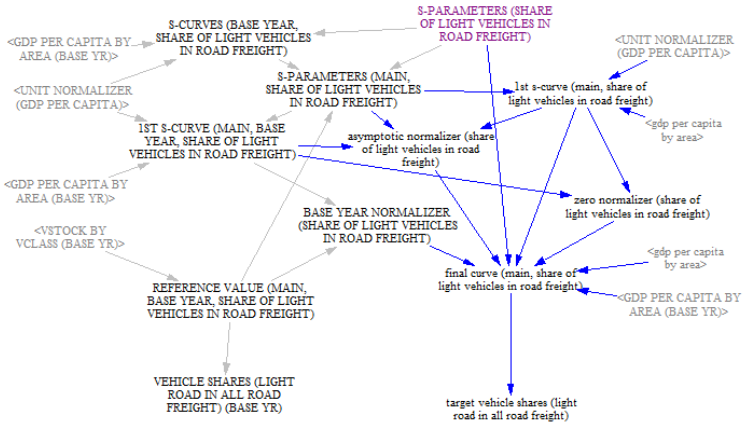
The view is intended to calculate the share of light vehicles in total road freight vehicles. The light road freight vehicles are those belonging to the TWO WHEELERS, THRE WHEELERS and LDVS modes, while total road freight vehicle includes also the LARGE ROAD mode (the latter also corresponds to the sum of the medium duty and heavy duty trucks of the large-freight sub-modes – LFT MDT and LFT HDT).

Structure

The share of light road freight vehicles in total road freight is assumed to be a function of the GDP per capita. As in the case of some of the variables of the passenger demand generation module, this function is defined by a curve whose shape across different level of GDP per capita is deduced from historical patterns. The S-Curve is calibrated with base year data.

Figure 10.1 shows the general appearance of the view.

Figure 10.1 Light road freight vehicle shares

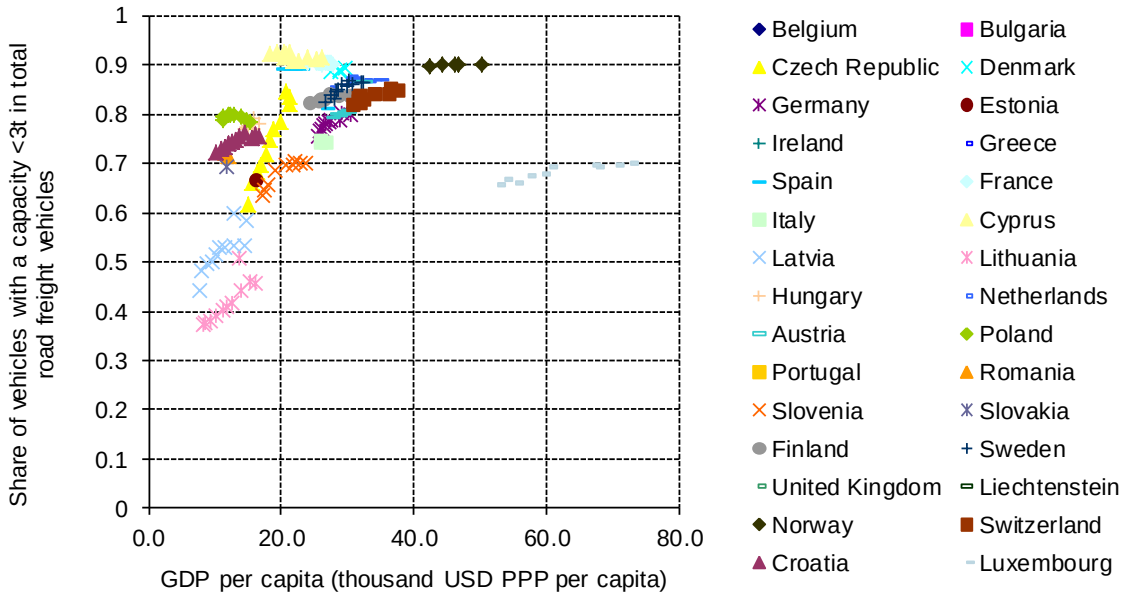


Detailed description of the view

The starting point for the calculation of the share of light road freight vehicles in total road freight is the definition of a family of S-Curves that represents the pattern followed across different values of GDP per capita and different base year values.

The basis for this definition is shown in Figure 10.2, showing a plot of the share of vehicles with a load capacity lower than 3 t in the total road freight vehicles for European countries. The growing share of light road freight vehicles shown in Figure 10.2 mirrors the growth of personal passenger vehicles observed when the average income increases.

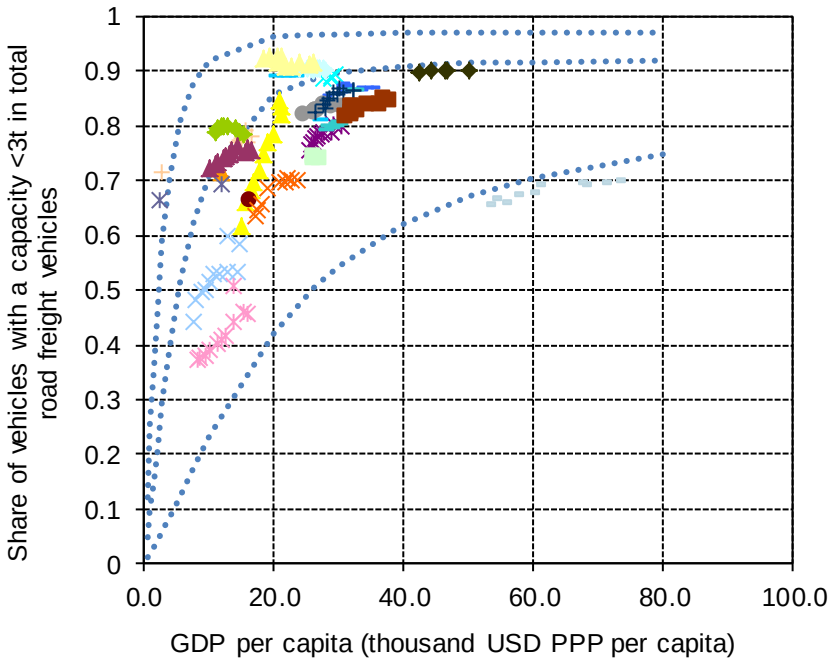
Figure 10.2 Share of vehicles with a load capacity lower than 3 t in total road freight vehicles



Source: Eurostat (2011)

Figure 10.2 is used as the basis for the definition of three patterns that define a family of possible S-curves characterizing the share of light road freight vehicles in total road freight (Figure 10.3). This family of S-Curves is combined with base year data to identify the final curve that is actually estimating the share of light vehicles in total road freight vehicles in ForFITS. The evolution of the GDP per capita over time is the input (X-AXIS) for this final S-Curve. This allows the estimation of the target light vehicles shares (Y-AXIS).

Figure 10.3 Family of S-Curves (LOW, AVERAGE, HIGH) on share of light vehicles in total road freight vehicles



Inputs

The variable "S-PARAMETERS (SHARE OF LIGHT VEHICLES IN ROAD FREIGHT)" is an exogenous input that contains the parameters used to define three S-Curves (LOW, AVERAGE, HIGH). These three curves characterize the family of the possible patterns of the share of light road freight vehicles in total road freight.

Each S-Curve is defined by a set of four parameters according to the next equation:

$$share\ of\ light\ vehicles\ in\ road\ freight = SCURVE\ A \times e^{-SCURVE\ B \times e^{-SCURVE\ C \times \frac{GDP\ PER\ CAPITA}{1000}^{-SCURVE\ D}}}$$

The exogenous inputs from the user regarding the GDP per capita ("Socio-economic data" sheet of the ForFITS Excel file) and the vehicle stock ("User inputs (BASE Y)" sheet of the ForFITS Excel file) at the base year enable to calculate the reference value to calibrate the initial/first S-Curve.

The GDP per capita over time specified by the user ("Socio economic-data" sheet of the ForFITS Excel file) is used as the driver to project the target share of light road freight vehicles in total road freight.

Outputs

Initial/First S-Curve

The share of light road freight vehicles at the base year, along with the initial GDP per capita, are used to define a calibration point on the plane sketched by the shares of light road freight vehicles (Y-AXIS) and GDP per capita (X-AXIS) (blue dots on the examples of Figure 10.4).

This reference value is used to calculate the parameters of the "initial/first S-curve" ("S-PARAMETERS (MAIN, SHARE OF LIGHT VEHICLES IN ROAD FREIGHT)"), i.e. the curve, within the family defined earlier, that contains the base year reference point (this is the curve shown in dark blue on the right side of Figure 10.4). The parameters defining this pattern are calculated proportionally to the gaps between the reference point and the corresponding points (at a value of GDP per capita corresponding to the base year) belonging to the family of S-Curves. These points (LOW; MEDIUM and AVERAGE), calculated in the variable "S-CURVES (BASE YEAR, SHARE OF LIGHT VEHICLES IN ROAD FREIGHT", are shown in yellow (LOW), red (HIGH) and green (AVERAGE) on the left side of Figure 10.4).

The "S-PARAMETERS (MAIN, SHARE OF LIGHT VEHICLES IN ROAD FREIGHT)" draw the initial/first S-Curve as the interpolation between the corresponding guiding curves.

When the reference value falls within the range set by the family of S-Curves (LOW to HIGH), the point will be always included by the initial/first S-Curve.

Figure 10.4 shows the most representative cases that may occur:

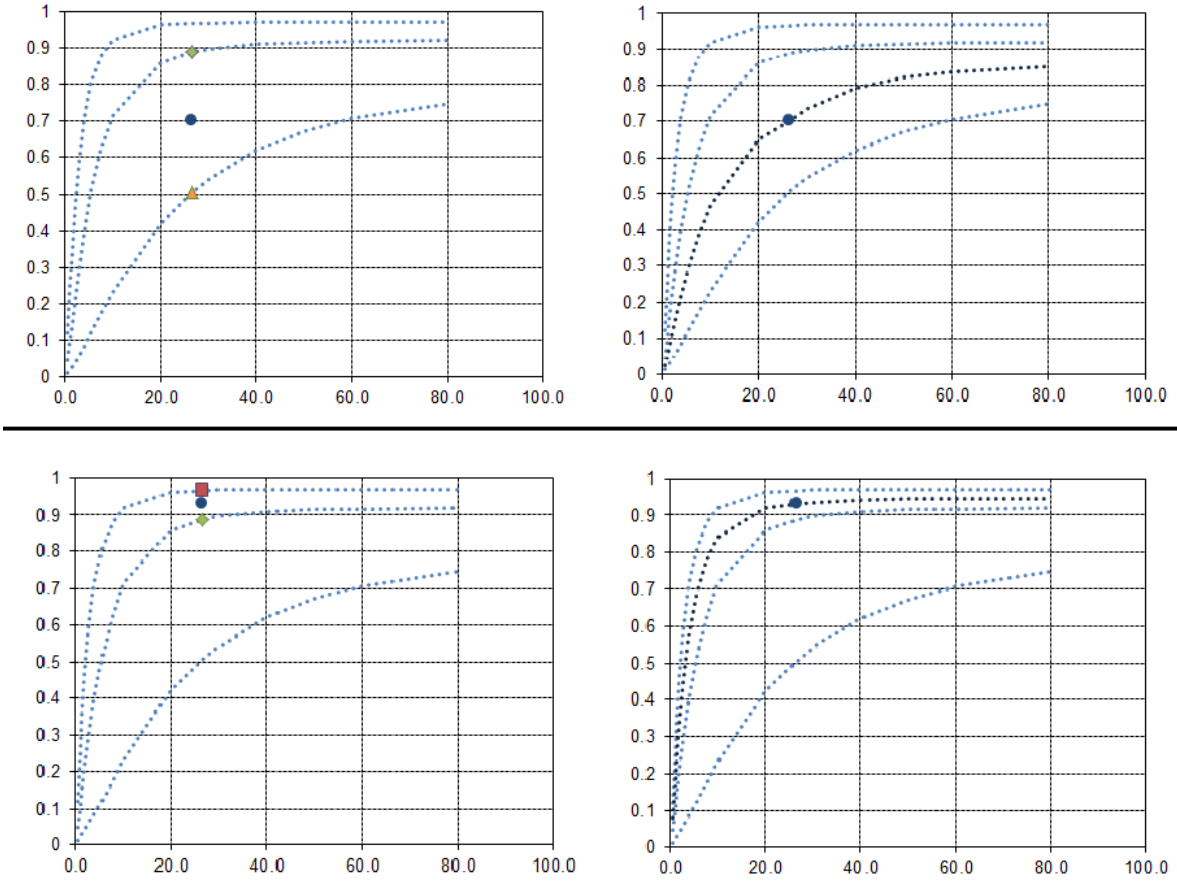
a) The reference value (base year) falls between LOW and AVERAGE

   The LOW and AVERAGE S-Curves guide the initial/first S-Curve accordingly to the gaps between the reference value and the points above (AVERGAE) and below (LOW).

b) The reference point falls between AVERAGE and HIGH

The AVERAGE and HIGH S-Curves guide the initial/first S-Curve accordingly to the gaps between the reference value and the points above (HIGH) and below (AVERAGE).

Figure 10.4 Calibration of the initial/first S-Curve when the reference value falls within the limits



In the exceptional case that the reference value is beyond the limits of the LOW and HIGH curves representing the family of S-curves, the "initial/first S-Curve" will not contain the base year point and will be drawn as follows (Figure 10.5):

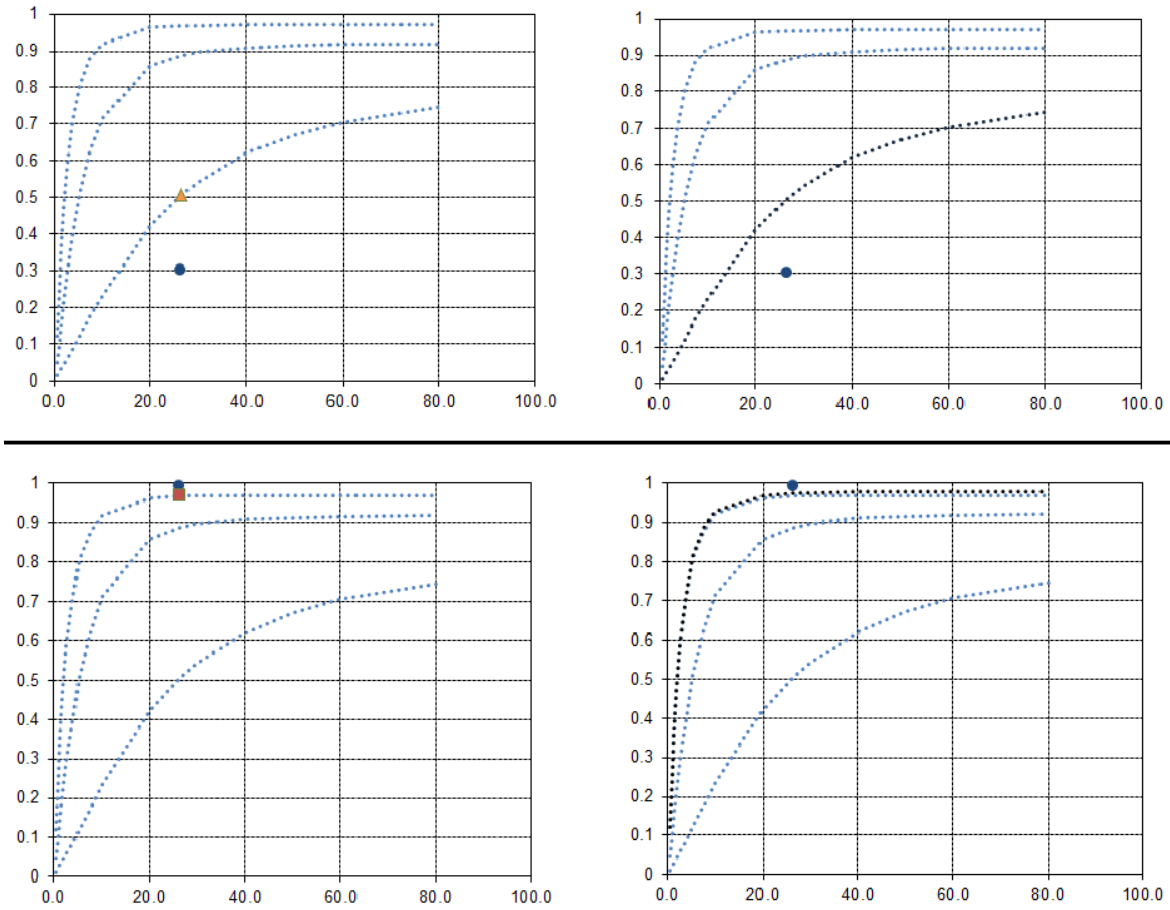
a) Reference value below the range

The initial/first S-Curve is considered as the LOW S-Curve.

b) Reference value above the range

The initial/first S-Curve is the HIGH S-Curve but adapting its asymptotic value proportionally to the gap between the reference value and the point belonging to the HIGH S-Curve and the ceiling of the function (maximum of 100% share).

Figure 10.5 Calibration of the initial/first S-Curve when the reference value falls beyond the limits



Final S-Curve (curve drawn in red in Figure 10.5)

When the reference value falls within the LOW and HIGH limits, the "final S-Curve" is the same as the initial/first S-Curve.

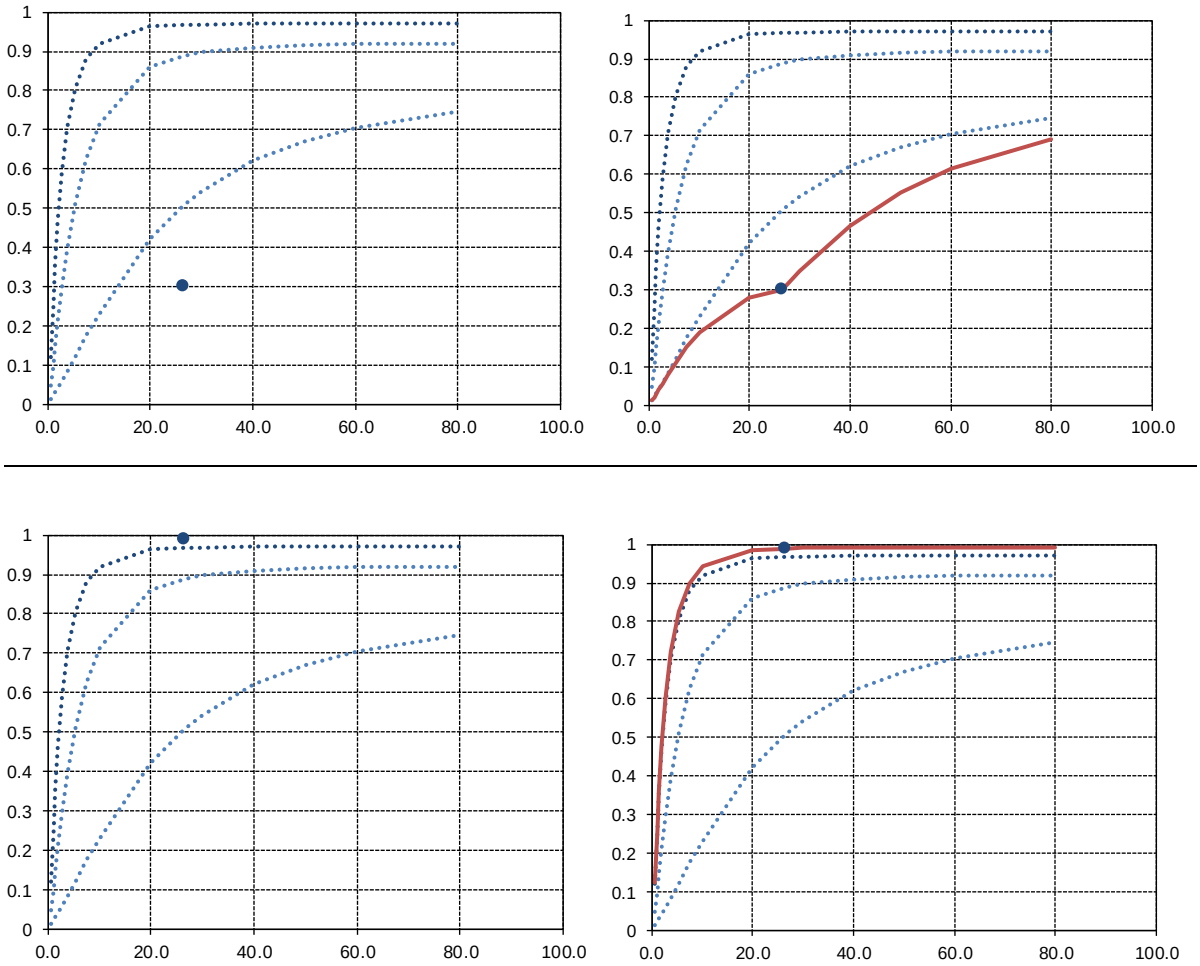
When the reference value is out of the LOW-HIGH range, then a further step ensures that the final S-Curve contains the baser year point. The procedure consists in drawing another S-Curve by means of normalizers that correct the initial/first S-Curve going through the reference value.

A "zero normalizer" carries out a weighted average between the reference value and the initial/first S-Curve along the X-AXIS. The "final S-curve" corresponds to the "initial/first S-curve" in zero and moves progressively towards the reference point when the GDP per capita approaches the reference value of the GDP per capita at the base year.

An "asymptotic normalizer" defines the second part of the curve, i.e. the section that starts on the reference point and, moving towards high levels of GDP per capita, gets closer to the initial/first S-curve.

Figure 10.6 shows how the final S-Curve is drawn through normalizers on the basis of the reference value and the initial/first S-Curve traced earlier.

Figure 10.6 Final S-Curve including the reference value



Targeting the share of light road freight vehicles in total road freight vehicles

The final S-Curve is used to forecast the share of light road freight vehicles in total road freight vehicles. In particular, the GDP per capita over time is the input (X-AXIS) selected to identify the target share as output of the function (Y-AXIS).

This share is then considered in the view "demand (freight)" to distinguish light and large-freight in the total road freight vehicles in the target stock. Combined with the estimate of large-freight road vehicles, this share allows figuring out the amount of light road freight vehicles. The latter, combined with information on average loads and average travel, leads to the estimation of the freight transport activity (expressed in tkm) of light road freight vehicles.

References

Eurostat (2011), *Lorries, by load capacity (number)*, data extracted in October 2011, http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database