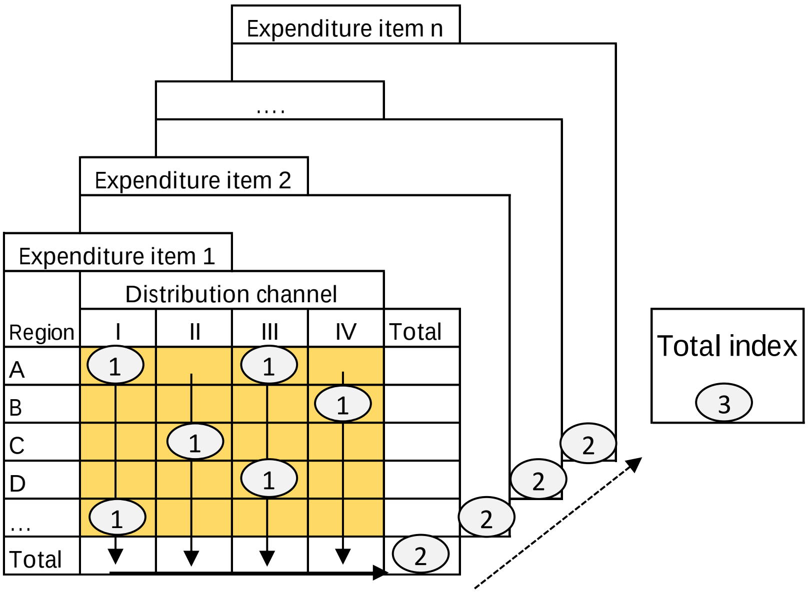
1.1 Calculation method

1.1.1 From basic aggregation to upper-level aggregation

Once prices have been collected and quality adjustment made, the sets of prices are converted into series of indices. How are the indices arrived at? How are elementary indices aggregated?

The prices are attached to three weighted levels: regions, distribution channels and the basket of goods and services, as illustrated in G 6.

G 1 Stages of aggregation of the Swiss CPI



Each cell (1) contains observations of non-weighted prices attached to a region, distribution channel and expenditure item (for instance, the price of flour collected in Neuchâtel in specialized shops). The first step in aggregation – the basic aggregation – consists of aggregating all these prices with the aim of obtaining one index per cell. The geometric mean (GM) is used for this purpose:

$$GM = \left[\prod_{i=1}^{n}\left(\frac{p_i^t}{p_i^0}\right)\right]^{\frac{1}{n}}$$

where:

n = the number of price observations

p_i^t = the price of commodity i during the month under review t

p_i^0 = the price of commodity i during the basemonth p_i

The geometric mean is greatly valued in price statistics because it has interesting mathematical properties, such as transitivity[1], which is very important in a chain concept (see upper-level aggregation below). Moreover, the results it provides take account of an elasticity substitution equal to 1 of individual items inside the cell which is more realistic economically speaking than the inelasticity translated by the Carli arithmetic mean[2].

The second stage in aggregation – intermediate aggregation – comprises aggregation of the indices obtained during basic aggregation. Regions and then distribution channels are aggregated using a weighted arithmetic mean, thus obtaining an index for each expenditure item (for instance, the index for the price of flour):

$$I_i^t = \sum_{l,k=1}^{x,z} g_l \times g_k \times I_{lk,i}^t$$

where:

I_i^t	=	the index of expenditure item i at the month under review t
$I_{lk,i}^t$	=	the index of expenditure item i at time t by distribution channel l and region k
g_l	=	the weighting assigned to distribution channel l (l=1,…,x)
g_k	=	the weighting assigned to region k (k=1,…,z)

The third and final aggregation phase – upper-level aggregation – enables calculation of the CPI at the total level. The index for each expenditure item, obtained during the second phase of aggregation, is weighted by the latter's respective weight in the basket of goods and services. Aggregation of these weighted indices gives, in hierarchical terms, a price index by product group, by main group and finally the total index. The formula used to calculate this aggregation is the Lowe formula (which is derived from Laspeyres formula):

$$I_{LO}^t = \sum_{j=1}^{n} g_j^{0b} I_j^t$$

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[1] The transitivity axiom requires that an index between T0 and Tn can be calculated by passing through the intermediate steps Tn-1, Tn-2, Tn-3….

[2] The Carli arithmetic mean or the mean of price relatives (MP**r**) consists of calculating an index for each set of prices and aggregating these indices arithmetically: $MRP = \frac{1}{n}\sum_{i=1}^{n}\frac{p_i^t}{p_i^0}$ This method assigns the same importance to each price variation.

where:

$$g_j^{0b} = \frac{q_j^b p_j^0}{\sum_{j=1}^{n} q_j^b p_j^0} \qquad \text{and} \qquad I_j^t = \frac{p_j^t}{p_j^0}$$

g_j^{0b}	=	the weight of commodity j during the base period
I_j^t	=	the index of commodity j for the month under review *t*
q_j^b	=	the quantity of commodity j surveyed during the base period (year t-2)
p_j^0	=	the price of commodity j during the base period (December t-1)
$q_j^b p_j^0$	=	the expenditure on commodity j during the base period (December t-1)
p_j^t	=	the price of commodity j during the month under review t

In a classic Laspeyres context, the weighting is kept constant for a comparatively long period of time. However, in reality, household consumption structure changes considerably from year to year. In order to take account of this change, the formula for the chained index according to the formula of Lowe has been used since December 2001. A chained Lowe index is a series of direct Laspeyres indices whose weighting is updated annually and whose results are linked up in order to produce long series of indices:

$$I_{T,m/0}^{LO} = I_{T,m/T-1,b}^{L} \times I_{T-1,m/T-2,b}^{L} \times .... \times I_{2,b/1,b}^{L} \times I_{1,b/0}^{L} \times \frac{1}{100^{n-1}}$$

where:

$I_{T,m/0}^{LO}$	=	the chained index for month m of year *T* compared with the base period
$I_{T,m/T-1,b}^{L}$	=	the Laspeyres index for the month m of year T compared with reference month b of the most recent period (T-1)
T	=	the year of reference
b	=	the month of reference (constant)
n	=	the number of links

The weights have been updated each year (see Chapter 2.2.2) in December (which represents „b" in the above formula), since 2001.

Using the chained index formula therefore makes it possible to update the basket weights annually and to incorporate changes to private household consumption structures quite fast.