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# Consumer Price Index with constant tax - the Swedish approach

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Statistics Sweden has a long history of calculating price indices with constant tax. The purpose of these indices is mainly to complement the Consumer Price Index (CPI) for the central bank of Sweden in the evaluation of monetary policy. Over the years different variants have been compiled by Statistics Sweden on behalf of the central bank. The fundamental way to deal with changes in indirect taxes and subsidies has although been the same, that is the direct effect of nominal changes in indirect taxes and subsidies is adjusted for resulting in a CPI (and CPI movements) exclusive of tax based influences.

How indirect taxation is constructed, either as a value tax or excise tax, impacts these measurements and therefore both must be considered individually when it comes to appropriate treatment and/or analysis. In an inflationary economy the excise tax share of the retail price reduces over time, i.e., when the tax rate is calculated on a kronor per unit basis, for example, SEK/liter. Most tax changes in Sweden are really only indexations (with the CPI) to preserve the tax share of the price over time (as opposed to policy based taxation changes).

Indirect taxes and subsidies followed, more or less, the CPI during the 1980s in Sweden (see Figure 1). During the 1990s taxes were increasing in real terms and lifted the inflation rate significantly. From the late 1990s Sweden experienced 10 years of indirect taxes and subsidies that were more or less stationary while the CPI increased by circa 15 percent. Despite higher consumer prices, taxes and subsidies have decreased by approximately 15 percent in the past years.

Figure 1 – Consumer Price Index and Index of indirect taxes and subsidies, 1980=100
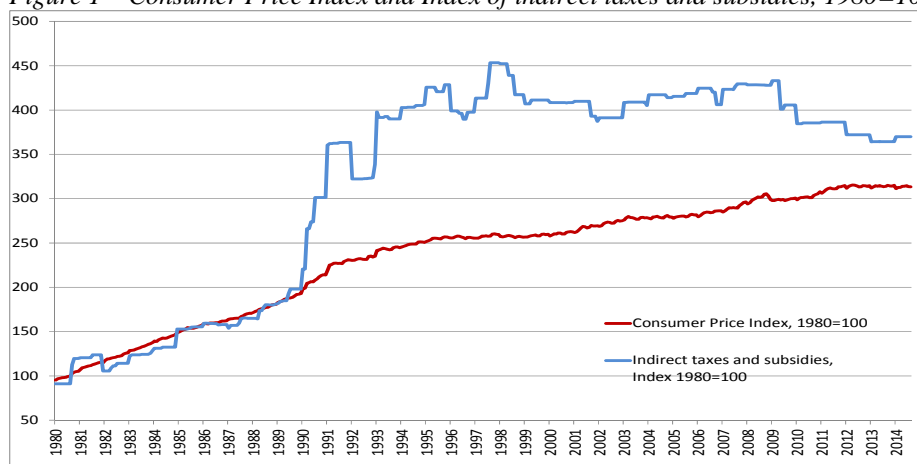
In a new index by Statistics Sweden, first published in 2014, CPI is adjusted only for tax changes beyond the normal indexation by the CPI, i.e., actual tax changes. Such a principle can be stated as a calculation of the CPI at constant tax in real SEK. This makes the treatment of value and excise taxes more similar.

The basic calculation method

Statistics Sweden defines CPI-CT as CPI excluding changes in the net total alterations in indirect taxes and subsidies, except of those related to wages. The basic calculation method is as follows:

$$\Delta\text{CPI CT} = \Delta\text{CPI} - (\text{effect from }\Delta\text{taxes} - \text{effect from }\Delta\text{subsidies})$$

The method involves the implicit assumption that changes in indirect taxes and subsidies have complete and immediate impact on consumer prices. The advantage of this is that it is a simple and unambiguous definition of the tax impact. A disadvantage is that this method may give misleading results as in practice tax changes are not always reflected immediately in same period price changes with full effect. One typical example when tax changes impact consumer prices with a lag is when the tax increase on cigarettes. Retailers, in this example, usually increase their pre tax-change inventories to gain short term competitive advantages.

The direct effect on consumer prices from changes in indirect taxes and subsidies are calculated from the total revenues of each tax and subsidy regardless of which consumer products they influence. The total effect, summed for all taxes and subsidies, is then subtracted from the change in overall consumer prices. An alternative to this method is to instead calculate the tax effects by products or elementary indices, i.e., bottom up approach. Both of these options should provide the same result, i.e., price movements as if no taxes had changed for the products in CPI.

In the Swedish method it is necessary to calculate a deduction for taxes and subsidies for each index link in accordance with the index structure used in the Swedish CPI[1]. The final Laspeyres-link is therefore calculated as follows:

$$\text{CPI CT}_{2013}^{2015,\text{jan}} = \text{CPI}_{2013}^{2015,\text{jan}} - \sum_{k \in S\&S} W_k^{2013} \times I_{k\,2013}^{2015,\text{jan}}$$

$\text{CPI}_{2013}^{2015,\text{jan}}$ is an index for the whole CPI, k is a specific tax or subsidy and *S&S* is the amount of relevant taxes and subsidies.

$I_{k\,2013}^{2015,\text{jan}}$ is an index that expresses the change in a specific tax or subsidy from 2013 (base period) to January 2015 (current period).

Weights for each tax and subsidy are calculated as follows:

$$W_k^{2013} = \frac{U_k^{2013}}{\sum_g U_g^{2013}}$$

U_k^{2013} is an actual and/or estimated revenue for each tax and subsidy respectively in a specific year.

$\sum_g U_g^{2013}$ is the total amount of CPI i.e. summed for all products.

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[1] For a more detailed description of the index construction in Sweden, please visit our website at www.scb.se

A new method for deduction of taxes and subsidies

This basic calculation method, described above, follows previous methods for indices with constant tax in Sweden. What is new about the CPI-CT is how the deduction of taxes and subsidies is treated.

There are several possible principles that may be used to exclude the effects of changes in taxes and subsidies in a constant tax index. A relatively simple and clear principle is to calculate a new tax deduction each time a tax or subsidy undergoes a nominal change. For an excise tax this is when the tax rate in dollars and cents changes and for a value tax this is when the tax rate as a percentage of the retail price changes. That is how the calculations were done previously in Sweden and also the method used in the harmonized index of consumer prices with constant tax (HICP-CT) as calculated within the EU.

In Sweden we have a significant amount of excise taxes, for example, taxes on energy, alcohol and tobacco. These tax rates are stated in per unit of a product, e.g., SEK/kWh, SEK/liter, SEK/gram, etc. In order to preserve the tax share of the price over time, excise taxes are normally indexed to the CPI. The tax rate is thus updated with the development of the CPI annually or with some other periodicity. In an inflationary economy the excise tax share of the retail price reduces over time.

A value tax, with the rate being a percentage of the retail price, automatically adjusts in line with the price change of the product. A value tax is thus, by definition, self-adjusting for inflation over time.

Adjusting for nominal changes in taxes has therefore resulted in some unwanted properties in our previous indices with constant tax. The reason is that the design of taxes had an effect on price changes. For an excise tax the calculation has in practice meant CPI with constant nominal tax, for a value tax the calculation has, in a sense, instead meant CPI with constant real tax.

An alternative principle is to instead adjust only for such changes in an excise tax that deviate from the general price development, i.e., the tax is not considered to have changed with just the annual indexation by CPI. Only changes beyond this real adjustment are adjusted for. Such a principle, which is followed in the CPI-CT, can be said to imply a calculation of the CPI with constant taxes in real SEK. This makes the treatment of excise and value taxes somewhat more similar to each other. However there is still a difference, as the inflation adjustment for a value tax follows the prices only on the specific products concerned, while for an excise tax it follows the general price development according to the CPI.

When calculating CPI-CT nominal changes in excise taxes are divided with the change in the CPI for the corresponding period. Thus the relationship between each tax rate development and the CPI basket in current value are kept constant, an example is given in Table 1 below:

Table 1 – deduction of taxes and subsidies in CPI-CT

Year	Month	Group - tax/subsidy	Product - tax/subsidy	CPI basket	Tax amount	Weight	Nominal tax change	CPI	Tax change in CPI-CT	VAT	Effect nominal	Effect CPI-CT
				1	2	3=2/1	4	5	6=4/5	7	8=3*4*7	9=3*6*7
2013	12	Energy tax	Petrol	1 487 189	10 775	0,72%	2,88	101,6	1,3	1,25	0,03	0,01
2013	12	Energy tax	Other petroleum products	1 487 189	106	0,01%	2,51	101,6	0,9	1,25	0,00	0,00
2013	12	Energy tax	Electricity	1 487 189	9 239	0,62%	3,53	101,6	1,9	1,25	0,03	0,01
2013	12	Real estate tax	Houses	1 487 189	10 256	0,69%	5,66		5,7	0,00	0,04	0,04
2013	12	Energy tax	Diesel	1 487 189	693	0,05%	15,82	101,6	14,0	1,25	0,01	0,01
2013	12	CO2 tax	Petrol	1 487 189	8 624	0,58%	2,46	101,6	0,9	1,25	0,02	0,01
2013	12	CO2 tax	Other petroleum products	1 487 189	402	0,03%	-3,95	101,6	-5,5	1,25	0,00	0,00
2013	12	CO2 tax	Diesel	1 487 189	1 373	0,09%	2,52	101,6	0,9	1,25	0,00	0,00
2013	12	VAT	Restaurants	1 487 189	162 259	10,91%	-4,46		-4,5	0,00	-0,49	-0,49
2013	12	Tax on alcohol and tobacco	Other tobacco	1 487 189	2 633	0,18%	14,47	101,6	12,7	1,25	0,03	0,03
2013	12	Tax on alcohol and tobacco	Cigarettes	1 487 189	9 228	0,62%	11,01	101,6	9,1	1,25	0,09	0,07
2013	12	Tax on alcohol and tobacco	Beer	1 487 189	3 186	0,21%	0,00	101,6	-1,6	1,25	0,00	0,00
2013	12	Tax on alcohol and tobacco	Spirits	1 487 189	4 348	0,29%	0,00	101,6	-1,6	1,25	0,00	-0,01
2013	12	Tax on alcohol and tobacco	Vine	1 487 189	4 505	0,30%	0,00	101,6	-1,6	1,25	0,00	-0,01
2013	12	Road tax	Congestion charge, Stockholm	1 487 189	535	0,04%	0,00	101,6	-1,6	0,00	0,00	0,00
		Total deduction - sum of the effects from each tax and subsidy									-0,25	-0,32

On the first line of Table 1 the CPI-CT are adjusted for the following change in the tax on petrol: (2.88%+100)/101.59*100-100= 1.27%.

Please note that taxes on alcohol and congestion charging (road tax) do not change in nominal terms but as the CPI has increased there is an actual negative effect on the total deduction of taxes on subsidies.

The calculation of tax and subsidy deductions are made in this way every month in accordance with the development of CPI. If no taxes or subsidies changed nominally, only the CPI is updated in the calculation of the monthly tax and subsidy deduction.

In cases when both excise and value taxes apply to a product, the amount of tax which is a value tax is first transformed into SEK per unit. It is then treated as an excise tax.

Weights used

CPI-CT has the same sum of weights as the CPI, that is the same budget amounts are used. In CPI-CT all taxes and subsidies that effect the consumer prices in a direct way are included in the budget amounts; it is only the effects from changes in taxes that are excluded in the calculations (held constant), and not the actual taxes or subsidies.

## Effects from holding taxes constant

Excise taxes in Sweden are pushed upwards or downwards in accordance with the CPI in order to preserve the tax share of the retail price over time. If the rates are not adjusted up with any regularity when general prices are increasing the real tax burden gradually decreases. In a stable economic environment, for example, an annual inflation rate of 2 percent decreases a specific tax by more than ten percent in only five years.

When a tax share of the price of a product decreases, the relative contribution from the tax to the price, and thus the overall consumer prices, decreases. If taxes are adjusted for nominal changes the deduction will be held constant, and if prices are increasing this will result in an excessive deduction which have a dampening effect on inflation.

The fact that a tax deduction based solely on nominal tax changes gets a dampening effect on inflation is shown in Figure 2. In the example the tax deductions (both nominal and those in line with the method for CPI-CT) are based according to an excise tax which is indexed each January. The tax share of the price is 10 percent of the fictive CPI basket, and inflation constant at 2

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percent, resulting in a tax that is indexed at 2 percent yearly. The red dotted line shows a constant, nominal tax deduction (tax change in January and the effect is accounted for the same amount during the whole year). A deduction where the same tax change is deflated by the general CPI inflation will instead drop gradually as prices go up (green dotted line). A constant deduction, based on the nominal tax change, generates a CPI inflation of 1.8 percent while according to the method of CPI-CT the inflation is 2.0 percent.

Figure 2 – inflation rate and deduction of taxes and subsidies according to CPI-CT and corresponding to nominal changes in taxes and subsidies
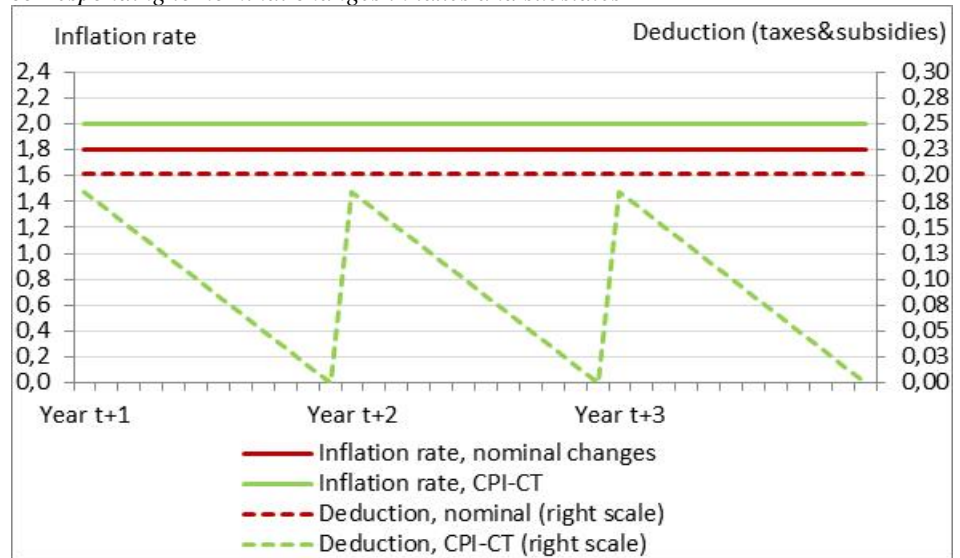
The example shows that inflation according to a constant tax index which only adjust for tax changes in nominal terms generates a lower inflation than would be the case if the adjustments are made according to the methods of the new CPI-CT. Figure 3 shows the actual outcomes for the two different methods based on Swedish CPI data for 1980 to January 2015.

*Figure 3 – inflation rates according to CPI-CT and corresponding with nominal tax changes, 1980-2015*
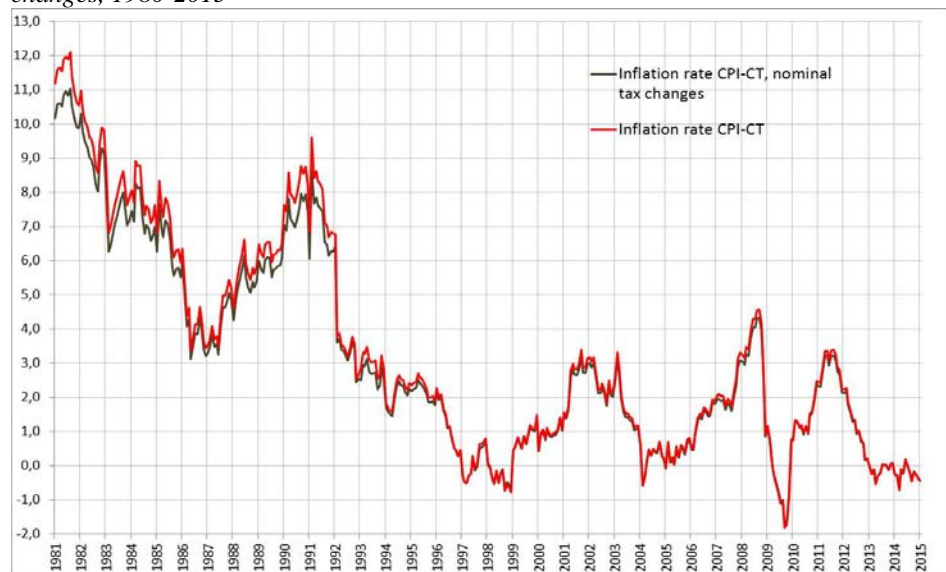
The average difference for the whole period is -0.24 percent. The effects are higher in periods of high inflation. Before the introduction of an inflation target

in Sweden in the early 1990s the difference were about -0.56 percent. After this (from 1993-January 2015) the effect is a more moderate -0.08 on average.

Comparison between CPI-CT and CPI

As seen in Figure 4, CPI-CT and the CPI are relatively close in price movement at least for the last 10 years, indicating small tax changes in addition to general price increases i.e. in practice most indexations.

Figure 4 – index (1980=100) and inflation rate according to CPI-CT and CPI, 1980-2015
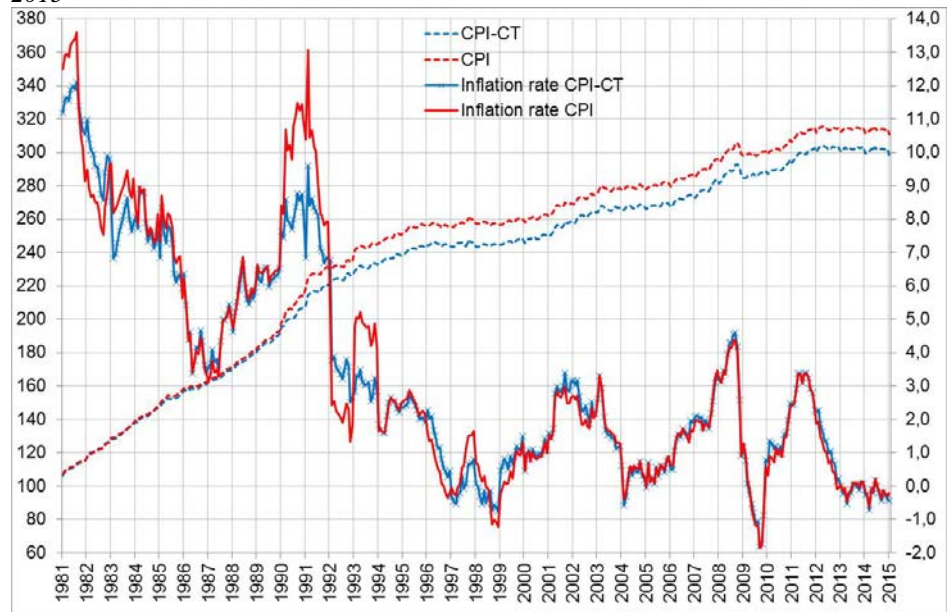
During the 1990s there were more significant differences between the CT-measure and the CPI. The VAT changed many times, for example on electricity, oil products and petrol in March 1990 and later in July the general level of VAT increased. In January 1992 a new major change in the VAT were introduced, as the general level were divided in two – one general and one reduced level. In January 1993 tax on petrol increased 30 percent, and in 1997 tax on tobacco increased in several steps to name only a few of many tax changes in the figure above.