

Nordbø, Einar W.

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Staff Memo

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Einar W. Nordbø, Norges Bank Monetary Policy, Economics Department

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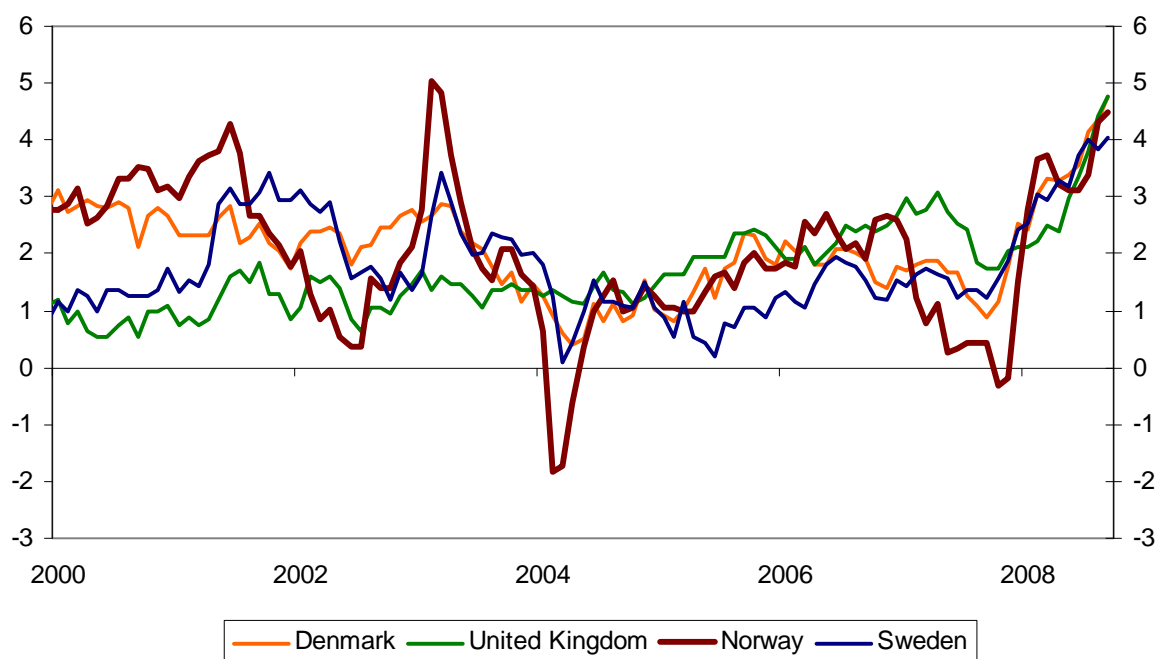
CPIXE and projections for energy prices

By Einar W. Nordbø¹

This paper describes the new indicator of underlying inflation used at Norges Bank, the consumer price index adjusted for tax changes and excluding temporary changes in energy prices (CPIXE). In particular, we discuss the projections for energy prices, which impact on the estimated trend change in energy prices in the CPIXE.

The operational target of monetary policy in Norway is annual consumer price inflation of close to 2.5% over time. The Norwegian consumer price index has been quite volatile in recent years, and more volatile than the consumer price index in some other countries, see Chart 1. Wide fluctuations in electricity prices have been one important factor behind the volatility in the aggregate index. As a result of the volatility, the monthly CPI numbers are not necessarily very useful in the assessment of inflation today and the inflation outlook ahead.

Chart 1. CPI in different countries. 12-month change

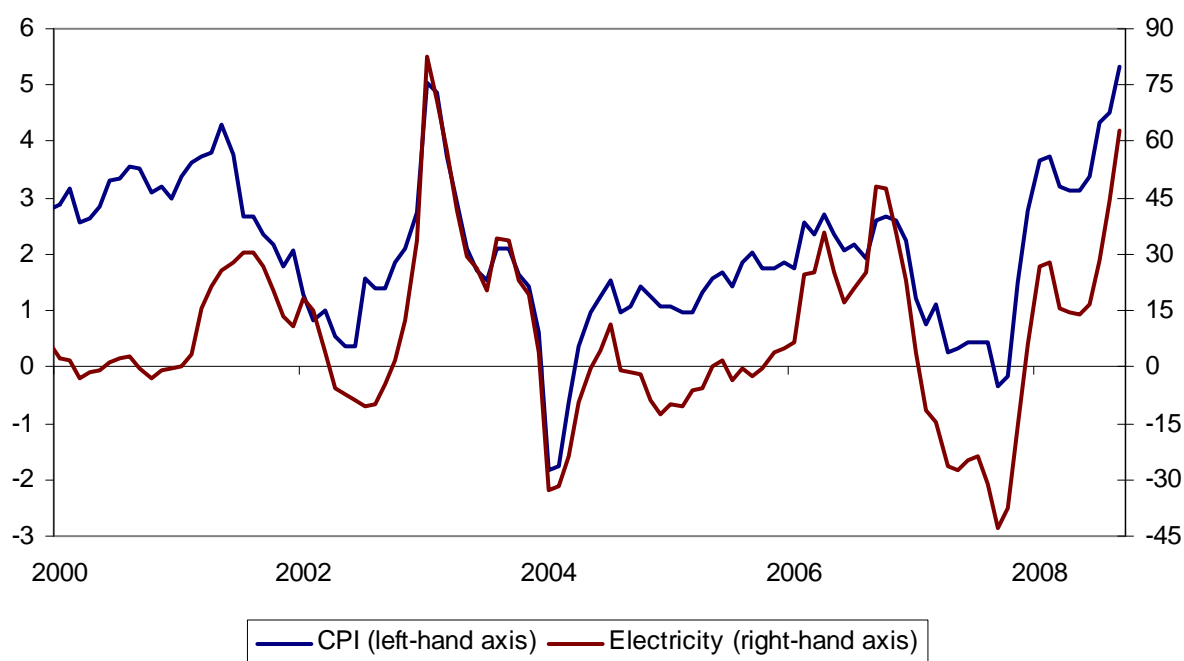


¹ I am grateful to Kåre Hagelund, Bjørn Naug and Ingvild Svendsen for helpful suggestions and assistance. All remaining errors are my own responsibility.

Most of Norway's supply of electricity is based on hydroelectric power. In 2007, unusually high inflows to water reservoirs led to low electricity prices. This produced temporarily low CPI inflation in 2007, whereas CPI inflation in 2008 has been very high as electricity prices have returned to more normal levels, see Chart 2. We saw similar fluctuations in the CPI, driven by electricity prices, in 2003 and 2004.

Indicators of underlying inflation seek to remove movements in consumer prices due to temporary disturbances.² Such disturbances should be disregarded when setting interest rates. Variations in inflows into water reservoirs and temperature, which affect electricity prices in Norway, are some examples of such temporary disturbances.

Chart 2. CPI and electricity in the CPI. 12-month change

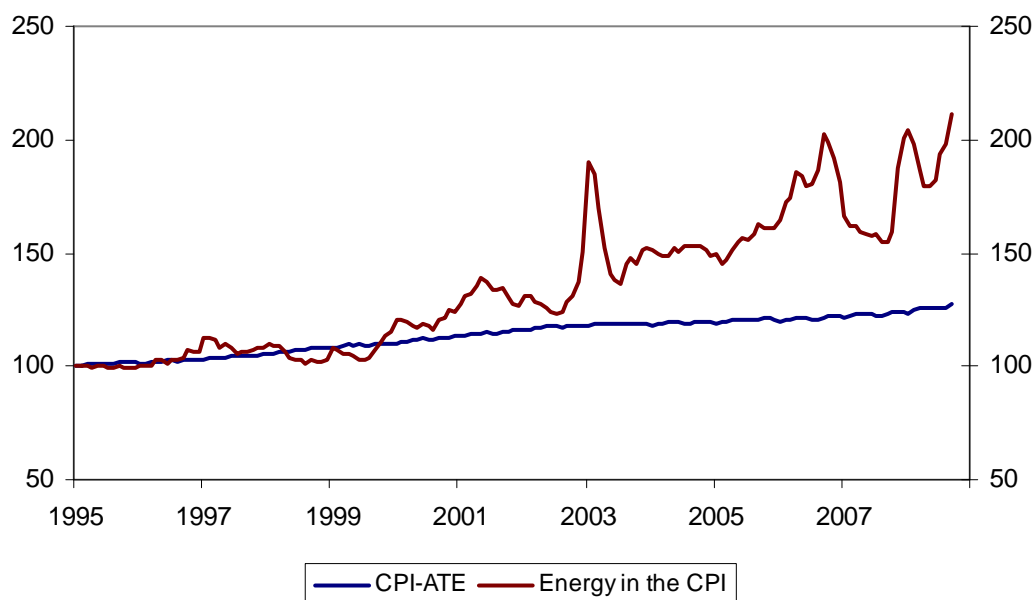


The consumer price index adjusted for tax changes and excluding energy products, the CPI-ATE, has often been used as an indicator of underlying inflation in Norway. Since energy prices are excluded, temporary fluctuations in electricity prices do not affect the CPI-ATE. However, in addition to being very variable, energy prices have increased faster than other prices since the late 1990s, see Chart 3. This reflects the international increase in the price of oil and other energy products. In addition, by expanding the power transmission to other countries, the price level of electricity in Norway has approached the European level. By excluding energy prices completely,

² See Jonassen and Nordbø (2006) and references therein for a discussion of indicators of underlying inflation.

the CPI-ATE has also excluded this trend change in energy prices, and thereby underestimated the overall inflation rate. This has been a substantial weakness of the CPI-ATE as an indicator of underlying inflation.

Chart 3. CPI-ATE and energy. Index. Jan 95 =100



The CPIXE, the consumer price index adjusted for tax changes and excluding temporary fluctuations in energy prices, is an alternative measure of underlying inflation developed by Norges Bank. The CPIXE was described in Nordbø (2008) and in a box in *Monetary Policy Report 2/2008*. The CPIXE is constructed as a weighted average of the 12-month change in the CPI-ATE and the 12-month change in an estimated trend for energy prices in the CPI. Formally, the new indicator is estimated as follows: $\pi_{XE} = \pi_{JAE}(1 - w_E) + \pi_E w_E$. π_{XE} is the 12-month change in the new indicator, π_{JAE} is the 12-month change in the CPI-ATE and π_E is the 12-month change in the energy price trend. w_E is energy products' weight in the CPI.

The energy products in the CPI, which are excluded from the CPI-ATE, are the subgroups *Electricity, gas and other fuels* and *Fuels and lubricants for personal transport equipment*. In addition, there are some energy products in the subgroup *Other services in respect of personal transport equipment* which are also excluded from the CPI-ATE. See Lilleås (2001) for details. Altogether, these groups constitute 8.5% of the weighting base in the CPI. However, energy products only constitute parts of the subgroup *Other services...*, but this share is not published by Statistics Norway. In the calculations of the CPIXE we have assumed that the

weight of energy products currently is 8.5%, that is, the sum of all the mentioned groups. This exaggerates the weight of the energy products somewhat, but since the weight of the subgroup *Other services ...* in the CPI is only 0.8%, our results are not significantly affected.

The energy price trend is based on the historical developments in the energy prices in the CPI and projections for energy prices into the future. The trend is estimated using a Hodrick-Prescott filter with a standard smoothing parameter for monthly data ($\lambda=14400$). Price developments for the energy products in the subgroup *Other services in respect of personal transport equipment* are not published by Statistics Norway. In the calculations, we have assumed that the trend change in these prices is similar to the trend change in the other energy prices in the CPI.

How the CPIXE is published

New monthly numbers for the CPIXE are published on Norges Bank's web site at 14.00 on the days Statistics Norway publish the CPI. The estimates of CPIXE are based on information that was available in the months the respective CPI-numbers were compiled. That is, the estimate of CPIXE in August this year is based on information from August, and the estimate of CPIXE in September is based on information that was available in that month, and so on. If energy prices differ from the projections, or the outlook for energy prices changes, the estimated energy price trend will change. However, the CPIXE series presented at our website is a real time series that is not revised.³ Alongside this series, we will also make available revised series of CPIXE, where the historical values of the CPIXE are based on the updated energy price trend. The "core" series will nevertheless be the real time series.

Projections for energy prices

In this section we describe the procedure used for projecting energy prices in the CPI. The projections are based on forward prices in the markets for electricity and oil. The forward prices may show substantial variations from day to day, and in order to prevent the estimated energy trend from being heavily influenced by single-day movements, we have chosen to take a ten-day average. That is, the monthly figures for the CPIXE are based on the forward prices from the last ten trading days in the month for the compilation of the corresponding CPI figure.

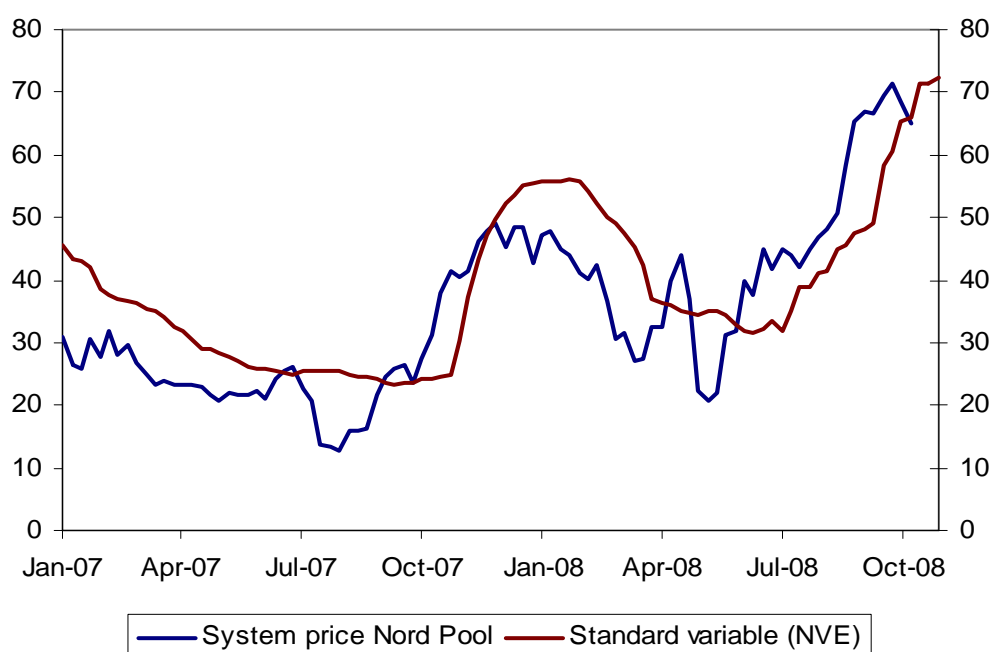
³ This procedure was started from August this year. The estimates of the CPIXE in the published real time series prior to August 2008 are based on the estimated energy price trend from August.

We normally assume that energy prices will develop in line with forward prices at least 12 months into the future. From then on, energy prices are assumed to develop in line with other prices. In most cases, forward prices will not imply a very different development at longer horizons.

Electricity prices

The projections for electricity prices are based on the Nordic forward prices on the Nord Pool Power Exchange. Monthly forward contracts are available six months ahead and quarterly contracts at least eight quarters ahead. The electricity price index in the CPI includes grid rent and electricity tax, which are much more stable than the spot price on the Nord Pool Power Exchange.⁴ Moreover, only about 40% of households have electricity contracts that are directly related to the spot price. About half of the households have so-called standard variable contracts, where suppliers are required to announce price changes two weeks in advance. The remaining households have contracts where the price is fixed for a year or more.

Chart 4. Standard variable contracts and Nord Pool system price (incl. VAT)



The price of standard variable contracts has often differed from the spot price, see Chart 4. The forward contracts on the Nord Pool Power Exchange reflect the market participants' expectations about future spot prices. Looking more than a few months ahead, we assume that

⁴ The electricity price index in the CPI is described in Henriksen (2007).

prices for the two contracts will develop similarly. However, the price of standard variable contracts is determined two weeks in advance and the price information is available on the web page of the Norwegian Competition Authority. If these prices indicate that the price of standard variable contracts will differ from the spot price, we adjust the projection for the respective months.

Another issue is that the Nord Pool forward contracts are related to the so-called system price, the average price for all Scandinavian regions. The price outlook in the three Norwegian regions may differ from the outlook for the system price.⁵ This was important in May and June this year, when high water reservoir levels and reduced transmission capacity abroad led to prices far below the system price in Southern Norway. A substantial price difference was expected to persist through the summer. In *Monetary Policy Report 2/08*, we therefore assumed a somewhat lower path for electricity prices in Norway in the coming months than implied by the forward rates.

Nevertheless, our projections for electricity prices have always converged to the path implied by forward rates within a quarter or so. These issues are important when forecasting the CPI in the short run, but the estimated energy trend in the CPIXE is not much affected by short and temporary deviations from the price path implied by forward rates. Therefore, these issues have only had limited implications for the estimates of CPIXE.

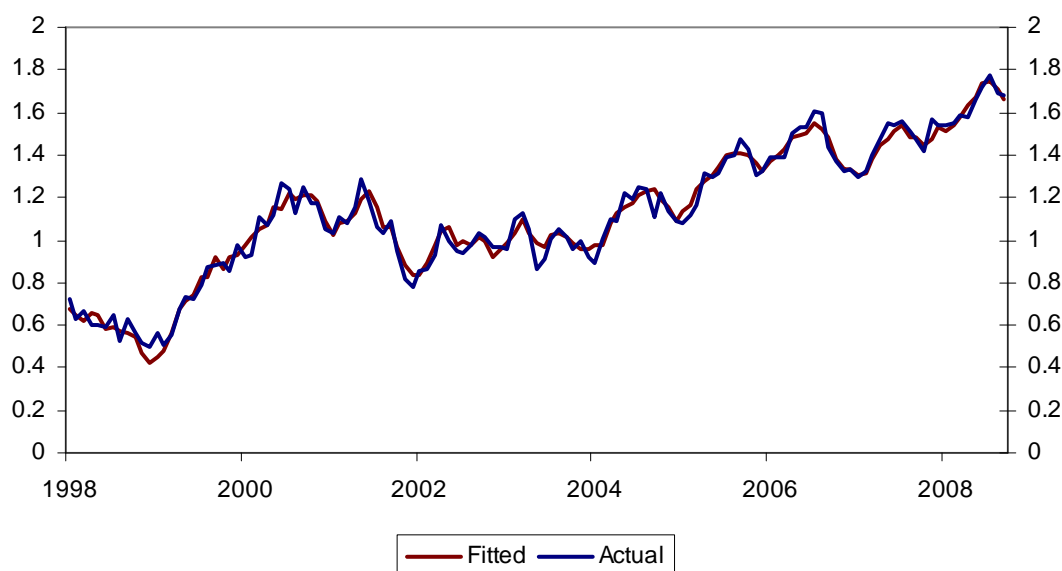
Fuel prices

Our projections for fuel prices are based on forward prices for oil. The relationship between the oil price and the petrol price in the CPI is not straightforward. This is partly due to the fact that petrol in Norway is heavily taxed. In spite of rapid increases in the oil price in recent years, taxes and duties still constitute about 60% of the sales price of petrol in Norway. In addition to being dependent on the oil price, the price of petrol is also influenced by the available refinery capacity, the competition between the different suppliers and developments in other costs. The relationship between the oil price and petrol price as measured in the CPI is further complicated by the fact that the CPI data are collected on the 15th in the respective month. As documented by Foros and Steen (2008), petrol prices in Norway have since 2004 followed a weekly pattern with price increases around noon on Mondays and price reductions during the rest of the week. Which weekday the petrol prices in the CPI are collected may therefore be important. An empirical model where the petrol price depends on the oil price (Brent Blend, in US dollars), the exchange

⁵ The three Norwegian regions, NO1, NO2 and NO3, cover the south of Norway, the middle part of Norway and Northern Norway, respectively. The spot price within the regions is similar, but prices may differ among the regions.

rate (NOK/USD) and seasonal factors can nevertheless explain the actual developments in the price of petrol relatively well, see Chart 5.

Chart 5. Petrol price excluding taxes. Actual and fitted (logs)



We model the petrol price (95 octane, unleaded) excluding taxes. The taxes include petrol tax, CO₂-tax and value-added tax. The historical values of these taxes and the petrol price, as collected by Statistics Norway, can be found on the web page of the Norwegian Petroleum Industry Association (www.np.no), an organisation representing the oil companies in Norway. The empirical model is a so-called error correction model estimated on monthly data.

The estimated model implies that a 10% increase in the oil price leads to a 6% increase in the price of petrol in Norway, excluding all taxes. Since the petrol tax and the CO₂-tax are fixed in nominal terms (NOK 5.15/litre altogether in the second half of 2008, increasing to NOK 5.30/litre from January 2009 according to the government budget proposal for 2009), the pass-through from the oil price to the price the consumers pay is more muted. With the price and tax level as of September this year, a 10% increase in the oil price would increase the sales price including all taxes by about 3%. A change in the NOK/USD exchange rate, for a fixed oil price in US dollars, would change the sales price in Norway in the same way, since it is the oil price in Norwegian krone terms that matters for Norwegian consumers.

Model for the petrol price, excluding taxes

The estimation sample is Jan 1998 – Sep 2008. Standard errors in (brackets)

$$\Delta fp_x_t = -1.40 + 0.39 \Delta oil_t + 0.61 \Delta usd_t + 0.38 (oil_{t-1} + usd_{t-1}) - 0.63 fp_x_{t-1} + \sum_{i=2}^{12} \alpha_i s_i + \varepsilon_t$$

(0.18) (0.05) (0.19) (0.05) (0.08)

$$R^2 = 0.63 \quad DW = 1.90$$

fp_x – petrol price excluding taxes (95 octane, unleaded)

oil – oil spot price (Brent Blend), measured in US dollars

usd – the exchange rate (NOK/USD)

s_i – monthly dummy variables (coefficient estimates are not reported here)

The symbol Δ signifies change from the previous month, $\Delta y_t = y_t - y_{t-1}$. All variables are in natural logs. The model is continually re-estimated, so the reported coefficients may change as new data become available.

The seasonal dummies in the estimated model are positive in the summer months and negative during the winter months. Norwegian firms' purchasing price for petrol is determined on the international market, and international demand is typically higher in summer. In particular Americans tend to drive more then, which has led to the period from May to September being referred to as the “driving season” the US.

In the projections for petrol prices, the oil forward prices are used as input and the estimated model generates a path for the sales price excluding all taxes. Taxes are added afterwards. We also monitor the actual developments in petrol prices on web pages such as DinSide.no.⁶ Here, unpaid volunteers report prices from various petrol stations, and this gives us an indication of how changes in costs feed through to retail prices. As with electricity prices, we may adjust the projections from the model if the information about the actual prices indicate a different price level. This concern is particularly relevant when the petrol prices for the CPI have been collected (on the 15th) but not yet published (normally on the 10th) in the following

⁶ See http://www.dinside.no/php/oko/bensin/vis_prisliste.php

month.⁷ But again, as with the electricity price adjustments, these adjustments have only limited influence on the estimated trend in energy prices and the CPIXE.

There are energy products in the CPI other than electricity and petrol. Liquid fuel (domestic heating) and solid fuels (firewood, etc.) are some examples. However, the other energy products have a small weight compared to electricity and petrol. We only make independent projections for electricity and petrol prices, and prices of the other energy products in the CPI are assumed to develop in line with these prices.

Summary

- The CPIXE is a new indicator of underlying inflation developed and calculated by Norges Bank.
- The CPIXE is published on the web page of Norges Bank at 14.00 on the days Statistics Norway publish the CPI. The published series is a real time series.
- The CPIXE is constructed as a weighted average of the 12-month change in the CPI-ATE and the 12-month change in an estimated trend for energy prices in the CPI.
- The energy price trend is based on the historical developments in energy prices in the CPI and projections for future energy prices.
- We make projections for petrol prices and electricity prices. Prices of other energy products in the CPI are assumed to develop in line with the prices of petrol and electricity.
- The projections for electricity prices are based on Nordic forward rates on the Nord Pool Power Exchange. We sometimes make adjustments in the first few months since the electricity contracts of most households are not directly related to Nord Pool system price. Besides, there may be price differentials between the different regions.
- The projections for petrol prices are based on oil forward prices, which are transformed into projections for petrol prices in the CPI by an empirical model. Again, we may make some adjustments in the first few months based on information about actual prices.
- We have only deviated from the path implied by forward rates for a few months. This may be important for our short-term CPI projections, but has only had limited influence on the estimated trend in energy prices and the CPIXE.

⁷ This was for instance the case in Monetary Policy Report 3/2008, which was published on October 29th.

- Energy prices are normally assumed to develop in line with forward prices at least 12 months ahead. Further on, prices are assumed to develop in line with other prices in the CPI.

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