Box 2. Producer and consumer prices and their relationship in Lithuania

Producer price index (PPI) is an inflation indicator of producer price changes, as well as price pressures in the production chain. If the prices of raw materials and other input costs increase for manufacturers, in order to maintain their profit margins, they increase the prices for the buyers of their production, such as other producers and traders, and due to this consumer prices eventually rise. Thus the producer price changes may affect consumer prices, measured by the HICP. While manufacturers can enter into supply contracts in order to obtain raw materials at fixed prices for a certain period of time, these contracts are finally changed. Pass-through of the increased producer prices to consumer prices may take some time, so the PPI could be useful as a leading indicator for the consumer prices.

The objective of this box is to review producer and consumer price developments in Lithuania and to determine whether changes in producer prices are leading indicator for consumer price changes. First of all PPI and HICP concept and limitations of their comparison are discussed, afterwards the producer and consumer price developments in certain groups of goods are examined and the correlation coefficients are calculated. This analysis shows that food and energy producer price changes are passed to consumer prices without significant delay. In the group of industrial goods excluding energy the changes in producer prices reach consumer prices after an average of 1.5 years. In this case, the PPI can be used as a leading indicator of inflation, albeit with reservations, because the maximum correlation coefficient in this group is about 0.6.

Producer and consumer prices: the concept, differences and grouping

PPI shows changes in actual selling prices of goods produced in Lithuania and sold in Lithuania and abroad1, while HICP shows developments of prices of consumer goods and services acquired and paid by households and used for their consumption. These indices have significant differences. Both PPI and HICP measure the developments of prices of some basket. PPI covers production which is manufactured and sold, so it covers not only the prices of production eventually purchased by households but also the prices of production which other manufacturers purchase as raw materials or as a capital investment. Also the PPI covers primarily the goods when the HICP covers whole consumer basket consisting of both goods and services. Since PPI is associated with output produced in Lithuania, import prices are not included in it. However, they are included in the calculation of the HICP, because this index includes prices of goods and services purchased by consumers for their consumption, regardless of where the products are manufactured. In addition, the prices included in the PPI are like producers’ income, thus consumption taxes (VAT and excise duties) are not included. Prices covered by the HICP show consumer expenditure on goods and services, so they include these taxes because consumers pay them. Also, the relationship between producer and consumer prices is weakened by the changes in retail profit margin as well as changing transportation, storage and similar costs.

It is useful to examine producer and consumer prices and their relationship not from aggregated data but under certain groups of goods, such as food (including beverages and tobacco), energy, industrial goods excluding energy groups from consumer price statistics (in 2012 in Lithuania they make up 34.4, 16.4 and 24.3% of the HICP basket respectively and about 75% when taken together). The most relevant PPIs could be found for these groups of consumer food. (including beverages and tobacco) and energy groups are available from producer price statistics, while the developments of industrial goods excluding energy consumer prices could be compared to the changes in producer goods excluding food2 producer prices (these producer prices, as well as the respective consumer prices, do not include food and energy). Services in this regard are not considered because they are not included in the PPI.

Producer and consumer prices in Lithuania in recent years

Regarding recent trends in food producer and consumer prices, it should be noted that their developments are closely related. The producer and consumer prices increase and decrease the most at similar time, and growth rates are quite similar at certain time periods (Chart A). The annual growth rate of food producer prices started to moderate in the second half of 2008 due to decelerating growth in global food prices. The deceleration was also observed in consumer food prices, but it was less pronounced compared to the producer prices. The most significant decline (of 7.5% year on year) in producer prices was recorded in October 2009, while the smallest annual growth of consumer prices was near to zero (at the beginning of 2010). Subsequently, in the context of rising global food prices, food producer prices increased more than consumer prices. Growth of food producer and consumer prices decelerated from about the middle of 2011. The situation in the energy goods market is quite similar (Chart B). It seems that the producer price changes without major delays are passed to consumer prices. Energy consumer prices vary much less than producer prices. Consumer price volatility is lower because excise duties constitute a significant proportion of the fuel, which is an important component of consumed energy.

When analysing the changes in consumer prices calculated based on constant indirect taxes, one can see even more similarities among the trends observed in the producer and consumer prices for both food and energy goods during the downturn period. In the context of a rapid decline in producer prices, consumer prices were sustained by raising the VAT rate a few times, cancelling the VAT privileges, and setting higher excise taxes.
The situation within the group of industrial goods excluding energy (Chart C) is different from that in food and energy groups. The producer and consumer price trends differed in this group. After a jump in 2006 to 2007, producer prices went down significantly in mid-2008 compared to the corresponding period a year ago, contrarily to the increase in consumer prices at that time (previously, in the context of robust growth in producer prices, they went up moderately). Hence, a delayed response of consumer prices to the increase in producer prices could be observed in this period. However, starting with 2009, price changes have been more similar. In 2009, price changes were broadly simultaneous, possibly due to the downward price pressures by severe economic downturn: growth decelerated in both the producer and consumer prices, and finally they decreased year on year. The largest decline in producer and consumer prices happened at the same time, at the beginning of 2010, and made up respectively 3.1 per cent and 3.9 per cent. However, consumer prices remained lower year on year for a longer period (for nearly two years) than producer prices (for 8 months). The decline in consumer prices for industrial goods would have started earlier and would have been deeper, if the VAT tariff had not been raised in 2009. Since mid-2011, the rate of change in consumer prices has been moderate and quite stable. Regarding the rate of change in producer prices, it declined at the end of 2011 and at the beginning of 2012.

**Statistical relationship between producer and consumer prices**

To produce a quantitative assessment of similarities between changes in separate groups of producer and consumer prices, we are going to calculate correlation coefficients for these data. Although a correlation coefficient reflects statistical data relationship between data and may help to summarise the development of several indicators, one should remember that its high value reflects just a similar development of two indicators rather than the causality, i.e. the indicators may change similarly because they are both affected by some third force rather than because of their interaction. Therefore, to interpret correlation coefficients one should apply economic logic.

We have calculated the correlation of indicators of the same period, which indicate the strength of the relationship between simultaneous price changes. Later, to find out whether any time lag exists for changes in producer prices to pass through to consumer prices, the coefficients of correlation between producer prices with subsequent consumer price data are calculated. In both cases, the January 2000 to May 2012 data have been used, a rather long time series for the calculated correlation coefficients to be reliable.

The earlier discussed charts A and B revealed close relationship between producer and consumer prices for food and energy groups; therefore, the same findings can be expected from calculating the strength of the relationship. Indeed, similar results have been received after computing the simultaneous correlation between the annual changes in the PPI and HICP for these groups: the correlation turned to be high, it is 0.83 for the energy group, and 0.82 for the food group. The correlation between consumer prices for non-energy industrial goods and the respective group of producer prices...
has been found to be weak (the correlation coefficient is 0.23).

Determining the period when the PPI and HICP relationship is the strongest, correlation coefficients were calculated using the 1-36 months later consumer price data. The highest correlation coefficient (0.84) between the annual changes of producer and consumer prices in both food and energy groups was obtained by taking one month later consumer prices\(^5\). So food and energy producer price changes affect consumer prices already in the next month. Again, the situation is different in the context of industrial goods excluding energy. In this case, the highest correlation (coefficient of 0.64) is got when taking 18 months later consumer price data, but it is quite similar (coefficient of 0.60 or greater) using 16-17 and 19-20 months later data. So producer price trends are most consistent with consumer prices after about 1.5 years and producer prices could be useful as a leading indicator of consumer price growth rate.

Chart D, constructed according to the period of largest correlation (changes in the producer prices are delayed by 18 months in order to be the most consistent with the consumer price developments), suggests that consumer prices should increase more quickly in the near future. However, based on the correlation coefficient, producer and consumer price trends for industrial goods reflect each other much less than in the food and energy groups. Therefore, producer prices are only partially suited as a leading indicator of the respective consumer prices, and they may significantly deviate from the trends that might be expected from the producer price changes.

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\(^1\) Analysing producer and consumer price relationship it makes sense to consider not a total PPI but only the PPI of the goods sold in Lithuania, since price developments of these goods, rather than those for export markets, may have an impact on consumer prices in Lithuania. In this box calculations related to producer prices covers PPI of production sold in Lithuanian market.

\(^2\) Producer prices of consumer goods excluding food do not include not only food but also energy, as according to the classification of producer prices energy products are not consumer goods, they are in a separate group.

\(^3\) It should be noted that the correlation coefficient value indicates the strength of the linkage, but is not interpreted. The value (strong or weak correlation) and the sign (positive or negative correlation) may only be stated. To get a result for interpretation, \(r^2\) (the coefficient of determination) has to be computed. The latter is the squared value of the correlation coefficient and it is interpreted as a proportion of variance of a particular variable, explained by other variable. For example, when the correlation coefficient is 0.8, \(r^2\) will equal to 0.64 meaning that 64 per cent of the variance of the first variable is explained by the second variable, and 64 per cent of the variance of the second variable is explained by the first variable, i.e. this is the percentage of variance shared by the two variables. However, we have chosen to analyse only the correlation coefficient as its interpretation in this case is less important. It is more significant to determine when the statistical relationship between the variables is the strongest.

\(^4\) The other limitations for the use of correlation coefficient are as follows: it measures only the strength of the linear relationship, and its value may change over time due to structural changes in the economy such as changes in the production process or technological progress.

\(^5\) In some other cases the correlation differs very slightly from the highest. In the food case, coefficient is 0.80 or higher taking the same period’s and 1-4 months later consumer price data, in the energy case – taking the same period’s and 1-2 months later consumer price data.