Box 5

Estimating underlying inflation using a dynamic factor model

The terms core inflation and underlying inflation are often used in discussions of monetary policy formulation and conduct. The terms are based on the idea that it is possible to isolate the components of inflation that are temporary from those that are more persistent and therefore likely to be difficult to control if inflation deviates too far from the inflation target. An increase in vegetable prices due to inclement weather, for instance, has a temporary effect on inflation which is corrected when the weather improves and therefore does not call for a monetary policy response. Other price changes are more persistent and are related to expectations of inflation, which affect households' pricing of labour and firms' pricing of goods and services. Other things being equal, inflation driven by such factors would call for a monetary policy response. The aim of estimating underlying inflation is to construct measures of inflationary pressures in the economy that look past temporary factors.

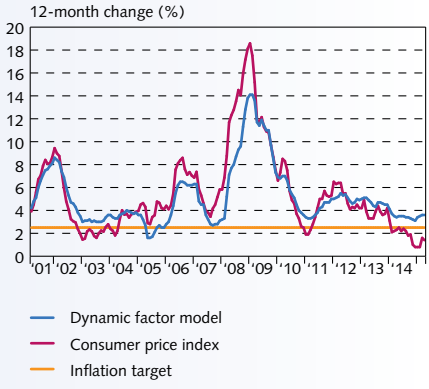
There are a number of methods available for measuring underlying inflation, but because there is no single method that clearly outperforms the others, central banks generally employ several of them. Two types of methods have been used to create the measures published in Iceland: exclusionary and statistical measures. Exclusionary measures attempt to exclude short-lived effects by omitting various components of the CPI. Usually, the most volatile components are excluded, or those that are considered to reflect supply shocks – such as oil prices or changes in indirect taxes, or prices set by the government. Statistical measures also exclude volatile CPI components but usually omit only the most volatile components in any given month. These can change from one period of time to another; therefore, the omitted components are not always the same ones, as they are with exclusionary measures.

At the request of the Central Bank, Statistics Iceland has for several years published four different measures of underlying inflation based on the exclusion method: core index 1, which excludes agricultural products and petrol; core index 2, which excludes public services as well; core index 3, which adds real mortgage interest expense to the list of exclusions; and core index 4, which also excludes the market value of housing.[1] In addition, the Bank calculates various statistical measures of underlying inflation: several trimmed mean measures, which exclude 5-25% of the components that change the most in price on a month-to-month basis, and a weighted median measure based on the price change of individual CPI components.

In a recent research paper, a new measure of underlying inflation for Iceland based on the so-called dynamic factor model is introduced.[2] In this factor model, 230 components of the CPI are used to find a single factor common to all of the components, which should reflect overall inflation developments. The results are shown in Chart 1. As can be seen, the measure tracks observed inflation relatively closely. The fluctuations are less pronounced, however, and the disinflation in 2014 is not as strong as it is in terms of observed inflation. This suggests that a portion of the moderation in observed inflation is due to temporary factors that will probably reverse. As Chart 2 shows, core index 3 also suggests this, although it, along with other measures, indicates a more rapid decline in underlying inflation than is obtained with the dynamic factor model.

In the paper, this new measure is compared with existing meas-

Chart 1
Underlying inflation according to the dynamic factor model
March 2001 - April 2015



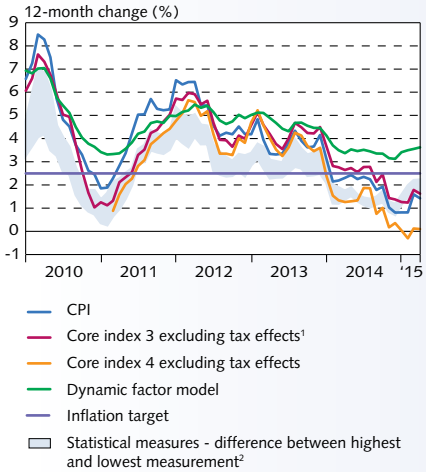
Sources: Statistics Iceland, Central Bank of Iceland.

1. An analysis of core indices 1 and 2 can be found in Thórarinn G. Pétursson (2002). "Evaluation of core inflation and its application in the formulation of monetary policy." *Monetary Bulletin* 2002/4.
2. Bjarni G. Einarsson (2014). "A Dynamic Factor Model for Icelandic Core Inflation". Central Bank of Iceland, *Working Paper*, no. 67.

Chart 2

Various measures of underlying inflation

January 2010 - April 2015



1. Core index 3 is the CPI excluding prices of agricultural products, petrol, public services, and the cost of real mortgage interest. Core index 4 excludes the market price of housing as well. 2. Underlying inflation is measured as the weighted median and as the trimmed mean, excluding 5%, 10%, 15%, 20%, and 25% of components with the largest price changes.

Sources: Statistics Iceland, Central Bank of Iceland.

ures of underlying inflation in Iceland, based on four characteristics. First, the measure should have a long-term average comparable to that for observed inflation, as it should reflect the same long-term trends as observed inflation. Second, it should have a lower standard deviation, as underlying inflation should measure the underlying trend in inflation, which should be less volatile. Third, it should be an unbiased predictor of future inflation. Finally, a measure of underlying inflation should be accessible without a significant lag, and new data should not lead to large revisions of existing estimates.

This comparison indicates that the dynamic factor model for underlying inflation is better than other measures over the period from March 1997 (which is as far back as core indices 1 and 2 extend) in that it has the same sample average as CPI inflation, as the core indices do, but the standard deviation is lower. For shorter sample periods corresponding to the first measurements with other measures of underlying inflation, the dynamic factor model matches average inflation less closely but is generally the measure with the smallest standard deviation, while the core indices have a comparable or even larger standard deviation than observed inflation. The trimmed mean and weighted median measures have a smaller standard deviation than observed inflation but match the mean of CPI inflation poorly. On the other hand, those measures have the greatest correlation with the output gap, which is often considered to have forecasting value for future developments in inflation, as it is a measure of domestic demand-side pressures.

The results also indicate that, of all measures, only the dynamic factor model and core index 1 are unbiased predictors of observed inflation. In addition, these two measures appear not to be affected by developments in observed inflation; therefore, they are weakly exogenous with respect to observed inflation. One of the drawbacks of the dynamic factor model, however, is that the estimation of underlying inflation for a specific period is subject to change when new data are added. That said, the results of the study indicate that the estimation of underlying inflation in Iceland is robust to the inclusion of new data.

Therefore, in Iceland, as elsewhere, no single measure of underlying inflation excels in all respects. The results of the study indicate, however, that the dynamic factor measure should be a valuable addition to the measures currently used by the Central Bank.