Box IV-1

Using high-frequency indicators to forecast private consumption

Developments in private consumption are an extremely important aspect of overall economic developments, as private consumption is the largest single expenditure item of GDP, with a share of over one-half. As a consequence, it is important that monetary policy decisions be based on the best possible information on developments in private consumption. Forecasting private consumption in Iceland is complicated, however, as it is quite volatile, much more so than in other industrialised countries.[1]

Assessments of private consumption – both recent developments the near-term outlook – often include an examination of indicators such as household payment card turnover, retail sales, and information on developments in consumer goods imports. A simple way to assess the underlying common trend of various variables is to apply principal component analysis. Briefly, principal component analysis involves finding the linearly weighted sums of data

1. See, for example, Box IV-1 in *Monetary Bulletin* 2010/2, "Fluctuations in private consumption."

series that best explain the variation in the data. These linear sums are called principal components, and usually 1-2 of them suffice to explain the bulk of the variation in the data.[2]

The Bank's forecasts of developments in private consumption are based mainly on its quarterly macroeconomic model (QMM). On the other hand, Statistics Iceland publishes its first national accounts estimates for any given quarter about two months after the quarter-end, when various high-frequency indicators are available. In order to utilise this information, it is possible to use principal component analysis to forecast private consumption for a period after that covered by national accounts data but for which high-frequency indicators are available. The variables examined are household payment card turnover, the product of real wages and the employment rate,[3] housing market turnover, real house prices, consumer goods imports, new motor vehicle registrations, and groceries turnover. All of the variables are monthly, seasonally adjusted, and in logarithmic form. The average for each variable has been deducted from the original data. The results of the principal component analysis can be found in Table 1.

Table 1 Principal component analysis

Principal component	1	2
Groceries turnover	0.16	0.63
Number of registered house purchase agreements	0.27	-0.54
Consumer goods imports	0.46	-0.01
Approximated real disposable income	0.45	-0.07
Payment card turnover	0.42	0.29
Real house prices	0.42	0.26
New motor vehicle registrations	0.37	-0.40
Cumulative variability ratio	64%	94%

It can be seen that all of the variables have a positive weight in principal component 1, and most are of similar size. The first principal component can therefore be interpreted as a common underlying driver of developments in all of these variables. It is mainly groceries turnover that is given a relatively low weight in the first component, but it weighs rather heavily in the second component, while others weigh less and some volatile items are assigned a negative weight. It can also be seen that the first component explains about 64% of the variability in the data, while the second component explains about 30%. These two components combined explain about 94% of the variability of the data most often used as a basis for short-term forecasts of private consumption.

Table 2 shows a strong contemporary correlation between several of the indicators, such as payment card turnover and consumer goods imports, and less between, for instance, groceries turnover and other indicators. This is probably because the subcomponents of private consumption vary in their volatility and the link between each indicator and each subcomponent varies.

If these two principal components are then used to forecast private consumption, it can be seen (Charts 1 and 2) that they give a good indication of how it develops (using quarterly averages

2. More specifically, the covariance matrix of the data series is calculated, followed by the eigenvectors of the set and their eigenvalues. The eigenvector with the highest eigenvalue is classified as the eigenvector of principal component 1, and so on. The eigenvectors are then used to calculate the principal components themselves (here as a time series) by multiplying them together with original data.
3. Obtained by deducting the Directorate of Labour unemployment rate from 1.

Table 2 Correlation matrix of private consumption indicators

	DVV	*FHS*	*INV*	*KM*	*GKV*	*RVH*	*NSB*
DVV	1						
FHS	-0.46	1					
INV	0.32	0.56	1				
KM	0.20	0.59	0.89	1			
GKV	0.69	0.20	0.87	0.78	1		
RVH	0.57	0.18	0.84	0.84	0.92	1	
NSB	-0.25	0.88	0.77	0.79	0.45	0.46	1

DVV = Groceries turnover; FHS = No. registered house purchase agreements; INV = Consumer goods imports; KM = Approximation of developments in purchasing power; GKV = Household payment card turnover; RVH = Real house prices; NSB = New motor vehicle registrations.

ofprincipal components in Chart 2). A simple regression gives the following equation:[4]

$$\ln(C_t) = \underset{(0.00027)}{11.862} + \underset{(0.0012)}{0.047}PC_{1t} + \underset{(0.0020)}{0.017}PC_{2t}$$

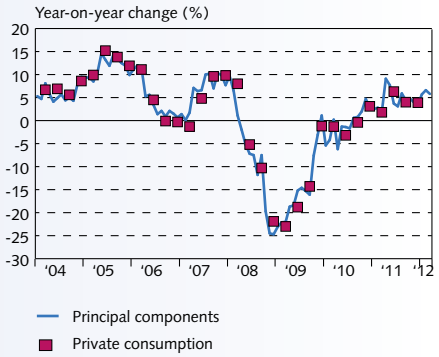
C_t represents seasonally adjusted private consumption, and PC_{it} represents the principal components. It can be seen that the first component plays a much larger role in explaining consumption movement than the second component, but the latter is still statistically significant. This equation is used to generate short-term forecasts of private consumption, whereas the Bank's QMM is used for forecasts over a longer horizon.

In order to test the forecasting quality of the model, it is possible to evaluate the model for a shorter period than the data series provide for and then forecast private consumption a few quarters ahead. Chart 2 shows how the equation performs in forecasting private consumption in Q3 and Q4/2011 by estimating the equation only until Q2 of that year. The chart indicates that the principal components prepared from these high-frequency data are very useful in evaluating recent developments in private consumption, but of course the forecast will always entail some uncertainty.

4. The regression also contains a dummy variable for Q4/2008 and a first-order autocorrelation component. Figures in parentheses show the standard deviations of the parameter estimates.

Chart 1

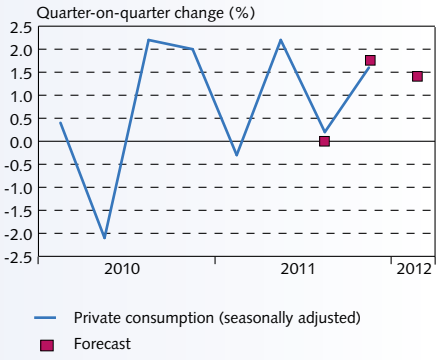
Private consumption and principal components of high-frequency indicators



Sources: Statistics Iceland, Central Bank of Iceland.

Chart 2

Private consumption and high frequency indicators



Sources: Statistics Iceland, Central Bank of Iceland.