Estimating the NAIRU in the Slovak economy[1]

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The NAIRU (Non-accelerating Inflation Rate of Unemployment) indicates the rate of unemployment that does not accelerate inflation. If the unemployment rate is lower than the NAIRU, then inflation will rise; in the opposite case, the economy produces output without making full use of production factors and inflation falls.

[1] *This article is an abridged version of an eponymous paper that sets out a detailed approach to estimating the equilibrium rate of unemployment in Slovakia, using a simple econometric model and a model with unobserved variables. It is published on the NBS website.*

NAIRU is, along with the output gap, another key factor in describing the cyclical position of the economy. The place of the NAIRU concept in the development of economic theory is briefly described by Ball (2002). As for the relationship between unemployment and inflation, it is captured by the Phillips curve. There is a close link between, on one hand, deviations of actual unemployment from the equilibrium rate of unemployment (the NAIRU) and, on the other hand, the output gap representing the cyclical fluctuation of the economy's total output around its potential level. This link is explicitly captured in the production function which, when used to estimate potential output, must include the equilibrium labour force. One option is to estimate the given equilibrium using the NAIRU concept. For the purposes of economic policy, NAIRU is therefore a key indicator that gives a clearer picture of the economy's cyclical position – the basis on policy instruments are set. In the case of Slovakia, another reason to analyse unemployment is its persistent relatively high level, which is often mentioned as one of the country's key economic problems. Estimating the NAIRU in the Slovak economy could bring a clearer understanding of the extent to which unemployment is the result of a cyclical disequilibrium or structural disproportions in the labour market.

The main aim of the paper on which this article is based is to estimate the equilibrium rate of unemployment in the Slovak economy, to compare the selected estimation approaches with other methods, and to verify the results against the findings of business cycle surveys. The following lines provide a brief outline of the subject, including non-technical results.

The NAIRU is an unobservable variable, and except for making a simple, but relatively unrealistic, assumption about its constant level (Hogan [1998] showed that the assumption of a constant NAIRU reduced the ability of the Phillips curve to explain the inflation observed in the USA), its trajectory needs to be estimated using some of the methods described in the literature:

- Statistical approaches – they extract the trend component from a time series of unemployment, or employment (unemployment is then calculated as the difference between the labour supply and number of employed). The drawback with them is the lack of economic information in the equilibrium trajectory of unemployment, which makes it impossible to interpret the causes of its estimated development. This group includes the trend analysis, moving averages, Hodrick–Prescott filter, and band-pass filter. Because of their simplicity, statistical approaches are often used for preliminary analyses or for estimating the equilibrium development of exogenous variables in macroeconomic models.
- Methods combining statistical approaches with economic information – a multivariate Hodrick–Prescott filter or Kalman filter.
- Econometric models that to various depths capture the economic links relating to unemployment, inflation, and the economy's output (the Okun law, Phillips curve, structural vector autoregressive [SVAR] model, wages and prices determination model).

The most suitable concept for estimating the equilibrium rate of unemployment in the Slovak economy appears to be the non-accelerating inflation rate of unemployment (NAIRU), considering that the country's monetary policy is focused on stabilizing the inflation at close to its target level. In order to estimate the NAIRU, two model approaches were used: a simple econometric model and a model with unobserved components using a multivariate Kalman filter. These models share the same background defined by the economic theory underpinning the NAIRU concept. The size and duration of the unemployment rate's deviations from the equilibrium level obtained using these two approaches are compared with the simpler statistical filters represented by the Hodrick–Prescott filter and band-pass filter, which do not take account of economic information. In summary, the economic interpretability of the results obtained from these estimation methods is set against "soft indicators" from the business cycle survey carried out by the Statistical Office of the Slovak Republic (SO SR), indicators of unemployment structure, and the results of other studies focused on foreign economies.

Scheme 1 Model structure and relations
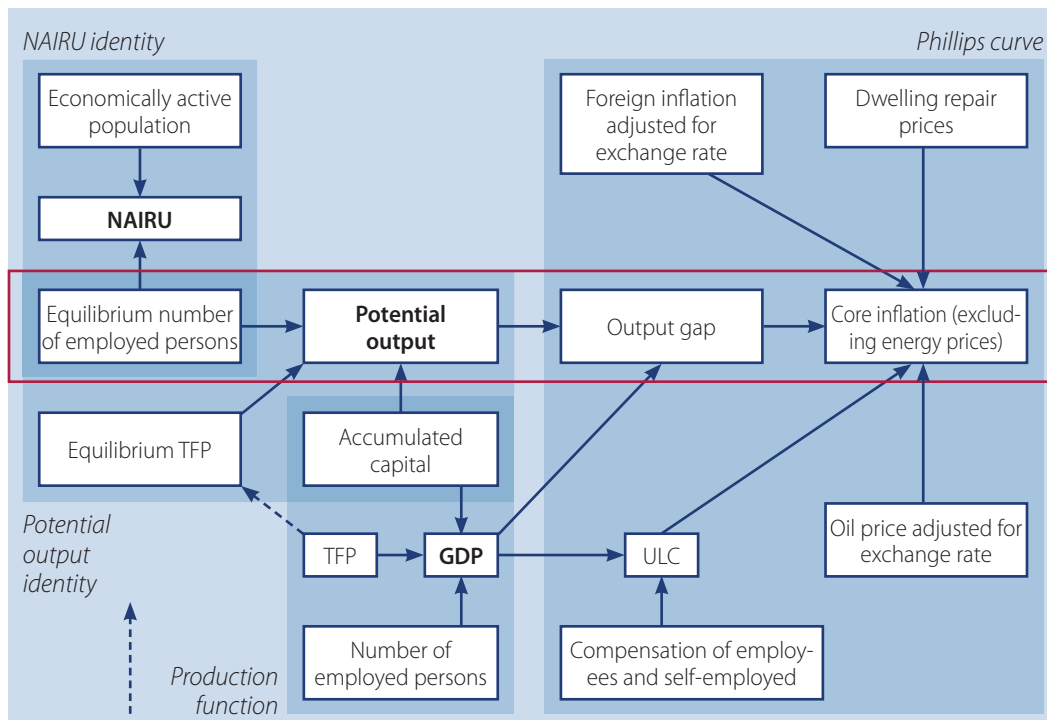
Source: The authors.

The structure of the model used is based on the definition of the NAIRU as the equilibrium rate of unemployment that does not accelerate inflation. The model must therefore include a link between the labour market, which determines the rate of unemployment, and the market in goods and services, for which prices and the inflation rate are determined. In the model solution process proposed by Hogan (1998), the sought-after equilibrium rate of unemployment corresponds to a certain equilibrium number of employed persons which, through the production function, generates such a level of potential economic output that the respective output gap in the Phillips curve, along with other explanatory variables, captures the actual development of inflation. The behavioural equations of the production function and Phillips curve are supplemented by two identities – one defining the equilibrium rate of unemployment through the exogenous labour supply and equilibrium number of employed persons, and another defining the output gap through GDP and its potential (the individual relationships in the model are shown in Scheme 1).

The level of inflation is determined by the extent to which the market in goods and services deviates from the equilibrium represented by the economy's potential output. The effect of the difference between the real and potential output – the output gap – is captured by the Phillips curve.

The inflation-determining market in goods and services is linked to the labour market using a Cobb–Douglas production function, which expresses the economic output level as a function of the basic production factors of labour and capital.

The NAIRU is estimated using the equilibrium number of employed persons obtained through solving the model for the number of employed persons in order to capture the actual development of inflation as accurately as possible.

The equilibrium number of employed persons constitutes a certain trajectory that leads, via the production function, to potential output and to the resulting output gap, with which the Phillips curve can best capture the course of inflation.

EMPIRICAL NAIRU ESTIMATE RESULTS AND RELATED VARIABLES

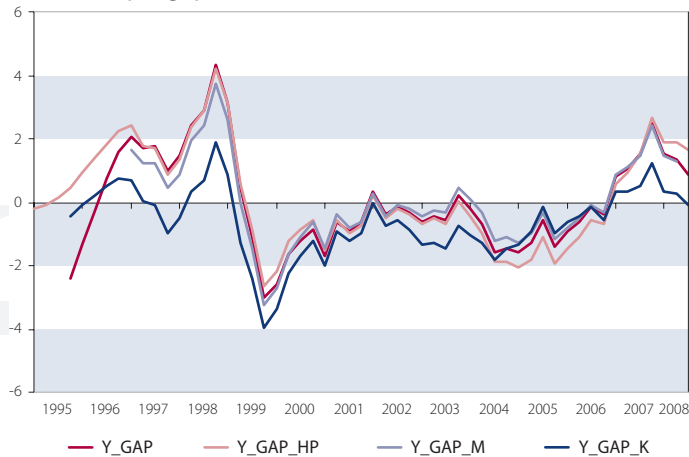The results of estimating the NAIRU by using a model with unobserved components and a sim-

Chart 1 The NAIRU range (in %)

Legend: The NAIRU range | Rate of unemployment | The NAIRU range excluding statistical approaches
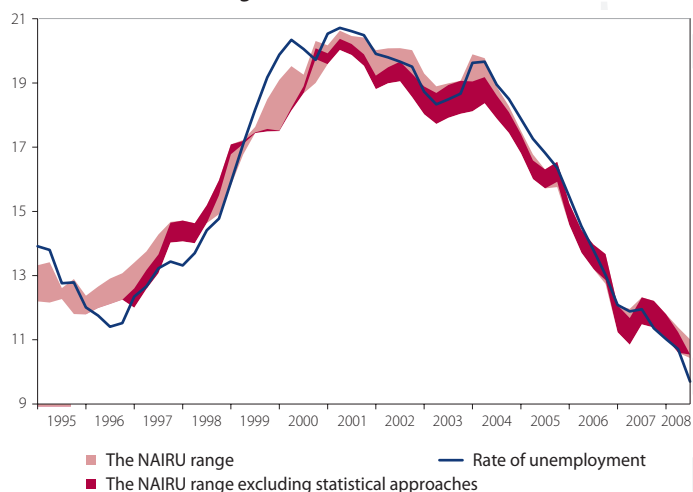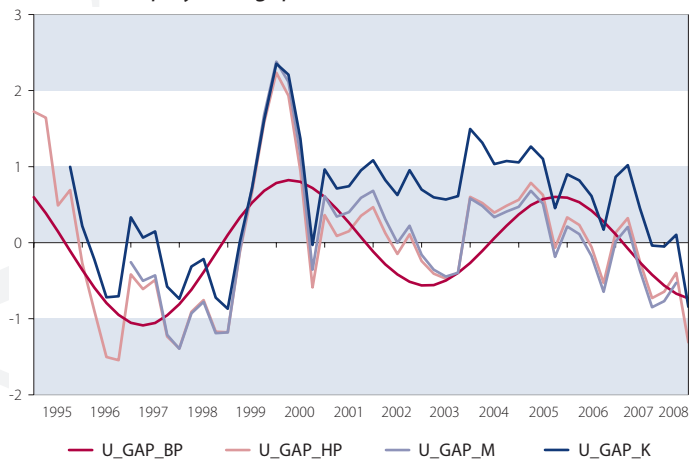
Source: Authors' calculations.

Chart 2 Output gap (in %)

Source: Authors' calculations.
Key: Y_GAP – output gap obtained using the production function; Y_GAP_HP – output gap obtained by smoothing GDP with a Hodrick–Prescott filter; Y_GAP_M – output gap from a simple econometric model; Y_GAP_K – output gap from a model with unobserved components using a Kalman filter.

Chart 3 Unemployment gap (in %)

Source: Authors' calculations.
Key: U_GAP_HP – unemployment gap obtained using a Hodrick–Prescott filter; U_GAP_BP – unemployment gap obtained using a band–pass filter; U_GAP_M – unemployment gap from a simple econometric model; U_GAP_K – unemployment gap from a model with unobserved components using a Kalman filter.

ple econometric model, in conjunction with the Hodrick–Prescott filter and band-pass filter estimates, create a range for the equilibrium development of unemployment. In Chart 1, this range is plotted against the actual unemployment rate.

In the development of both the actual and equilibrium rate of unemployment, two basic periods can be identified. From 1997 to mid-2001, when unemployment peaked, the prevailing trend was a rising unemployment rate due to the continuing economic transformation – a process which required structural changes in the economy and which led to the rationalization of the number of employees, i.e. to the closure of several businesses and a downturn in labour demand. From the second half of 2001, the economy gradually began to show the beneficial effects of foreign direct investment inflows (supported by economic reforms),

which had initially focused on the purchase of state enterprises and later included investments in a range of areas, from infrastructure to greenfield production facilities. The effect of these investments, as well as their secondary impact of increasing growth in other economic sectors, persisted to the end of period under review. During this period of the Slovak economy's development, the unemployment rate gradually declined to less than half of its previous all-time high.

The deviations of GDP (Y_GAP) and unemployment (U_GAP) from the equilibrium obtained through statistical approaches are smaller and shorter-lasting in comparison with the results obtained from the model with unobserved components (Kalman filter). The economic information taken into account (including the development of inflation in relation to the level of economic activity in the Phillips curve, and the link between total economic output and the utilization of labour in the production function) reveals more pronounced and longer-term periods of disequilibrium in the Slovak economy. Where the simple econometric model of the NAIRU is used, the deviations of GDP from its potential are generally slightly lower, and the unemployment gap is moderately wider, in comparison with the figures from statistical approaches. The fact that the NAIRU model is more similar to the results of statistical filters than is the model with unobserved components is due to the use of these filters in determining the equilibrium values of total factor productivity (when calculating potential output) and in the process of estimating model parameters.

Based on the estimates of potential output and the NAIRU, it is possible to identify the increasing overheating of the economy at the beginning of the period under review – over the period from 1995 to 1998 – which gave rise to substantial trade and fiscal deficits. The rate of unemployment in the first two years was falling from higher levels caused not just by the structural changes related to the transition from a planned to market economy, but also by the partition of the Czech and Slovak Federal Republic, until it decreased below the NAIRU level. The rate remained below that level (i.e. close to the lower end of the range of NAIRU estimates produced by alternative approaches) until 1999, when the government adopted restrictive measures that led to a sharp slowdown in economic activities together with a temporary overshooting of the equilibrium level. This resulted in a negative output gap and a gradual increase in the rate of unemployment, which rose above the NAIRU and peaked in 2000. In 2001 and 2002, the unemployment rate continued to fluctuate mostly above the NAIRU (or close to the upper end of its range – if account is taken of the statistical approaches, which tend, in the long run, to remain close to the actual data), accompanied by a negative output gap. In 2003, the unemployment rate briefly returned to the lower half of its equilibrium range, which approxi-

mately corresponded to a temporary narrowing of the negative output gap. That GDP continued to remain below its equilibrium in the years 2004 to 2006 was caused also by the gradual acceleration of potential output – facilitated by economic reforms designed to boost the inflow of foreign direct investment, which had a positive effect on capital and especially TFP. The fact that the unemployment rate during this period was higher than the NAIRU indicates a certain degree of inflexibility in the labour market, which may explain why the sustainable rise in the number of employed persons lagged the dynamic potential economic growth. In 2007 and 2008, all approaches point to overheating of the economy, but this is only temporary given the expected adverse impact of the financial crisis. The launch of production at new FDI enterprises in the automobile and electronics industries – which for the economy represents a unique, positive supply shock, one that is hard to capture using models estimated on historical data that do not cover any changes of similar intensity – implies that potential output may not be exceeded by as large a margin as had been indicated. The continuing decline in the unemployment rate in these years meant that it returned to the estimated range of the NAIRU and that it exceeded the range at the end of the period under review.

COMPARISON OF THE NAIRU WITH LABOUR MARKET INDICATORS

The estimate of the NAIRU, like other unobservable variables, depends on the method used. In order to confirm the results obtained, it is advisable to ascertain whether the conclusions drawn from them are supported by other economic indicators. In our case, we selected a comparison with qualitative evaluations made as part of the business cycle survey.

The expected change in the number of employees in individual sectors is ascertained in business cycle surveys of the Statistical Office of the Slovak Republic. On average, for all sectors over the whole period under review, a preponderance of firms expected a decline in the number of employees. However, the prevalence of expectations of a reduction in number of workers changed over time. In those periods when firms' expectations were more pessimistic about the level of employment compared with the historical average (especially in 1999 and 2004), the rate of unemployment rose within a relatively short time above the NAIRU. Similarly, during those periods when unemployment was lower than the NAIRU, or fluctuated within its estimated range, the overall tendency of firms to lay off staff was lower. To better illustrate the relationship between the unemployment rate and the average expectations of firms concerning the number of employees for all sectors, Chart 4 shows the deviations of this indicator, in percentage points, from its average level for the entire observed history (since the predominance of firms' expectations for a decline

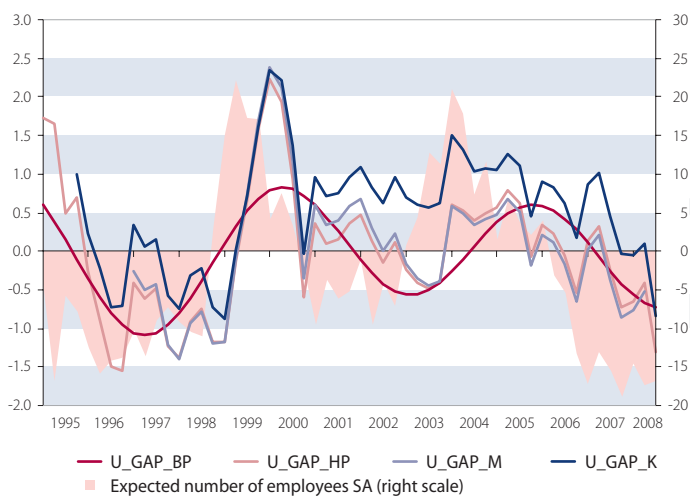### Chart 4 Unemployment gap and expected number of employees

— U_GAP_BP   — U_GAP_HP   — U_GAP_M   — U_GAP_K
■ Expected number of employees SA (right scale)

Chart 5 Unemployment gap and shortage of employees

— U_GAP_BP   — U_GAP_HP   — U_GAP_M   — U_GAP_K
■ Limiting factors: shortage of employees (right scale)

Chart 6 Unemployment gap and job vacancies
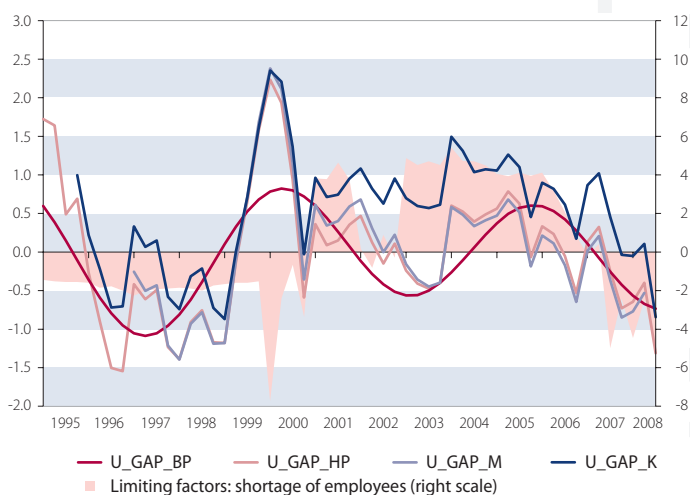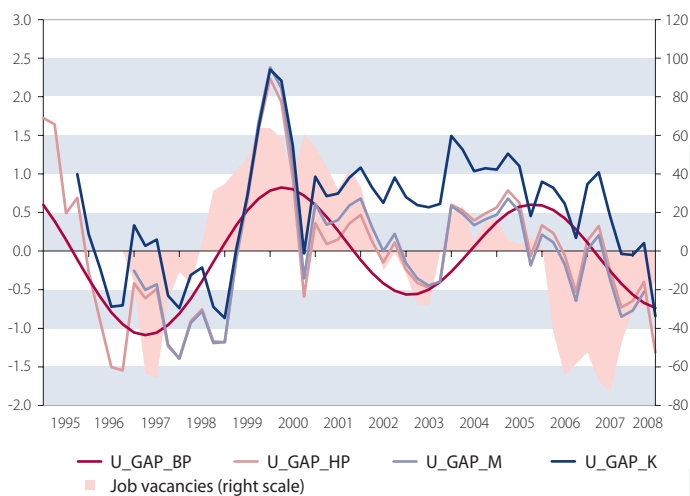

— U_GAP_BP   — U_GAP_HP   — U_GAP_M   — U_GAP_K
■ Job vacancies (right scale)

Source: Centre of Labour, Social Affairs and Family; authors' calculations.
Key: U_GAP_HP – unemployment gap obtained using a Hodrick–Prescott filter; U_GAP_BP – unemployment gap obtained using a band–pass filter; U_GAP_M – unemployment gap from a simple econometric model; U_GAP_K – unemployment gap from a model with unobserved components using a Kalman filter.

in employees corresponds to the higher rate of unemployment, opposite values of the indicator deviations are plotted) and compares them with the deviations of the unemployment rate from the NAIRU.
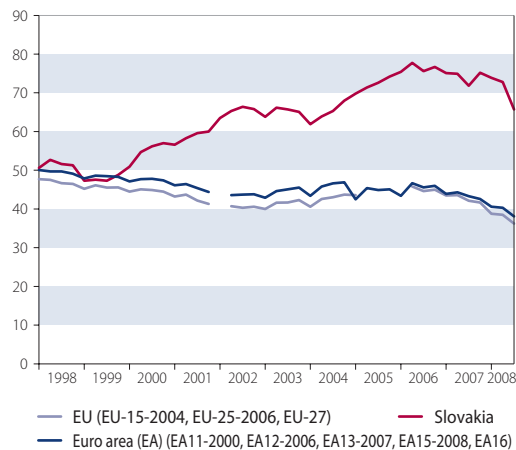
Another part of the business cycle survey relating to the labour market situation seeks to establish whether a shortage of employees is a limiting factor. For as long as this indicator has been monitored, the proportion of firms limited by labour supply has been relatively low, which could be caused by the persistent, relatively high rate of unemployment in Slovakia. In the period 2003 to 2006, across the whole economy, the proportion of firms experiencing a labour shortage was at an historical low and the unemployment rate, reflecting the sufficient labour supply, soon rose above the NAIRU. In 2007 and 2008, there was a sharp rise in the proportion of firms constrained by the availability of labour, which was in line with the estimated overheating of the economy and the gradual decline in the unemployment rate to below the NAIRU. The fast pace of this rise could

also, however, be partially attributed to the outflow of labour to foreign countries that occurred after Slovakia joined the European Union (under the EU's free movement of workers). In Chart 5, as with the previous indicator, the development of the unemployment rate's deviations from the NAIRU is compared with the deviations in the proportion of firms (across all sectors under review) experiencing a labour shortage from the historical average proportion (the opposite deviation values in percentage points were again used, since a higher perceived labour shortage implies a lower rate of unemployment).

The deviation of the unemployment rate from the NAIRU may also be compared with the number of job vacancies reported by the Centre of Labour, Social Affairs and Family. This indicator is better illustrated in Chart 6, which, as in the previous cases, shows (as opposite values) the percentage deviations in the number of job vacancies from the average number (since an above-average number of job vacancies implies a lower rate of unemployment). Again, it is possible to observe the correlation between the deviations of unemployment from the equilibrium and the fluctuations in the number of job vacancies. During periods when the number of job vacancies was relatively high, i.e. 1997–1998 and 2006–2008, the unemployment rate fell with a lag to below the NAIRU. When the number of job vacancies was below average, particularly in the period from 1999 to mid-2002, the unemployment rate rose above its equilibrium level.
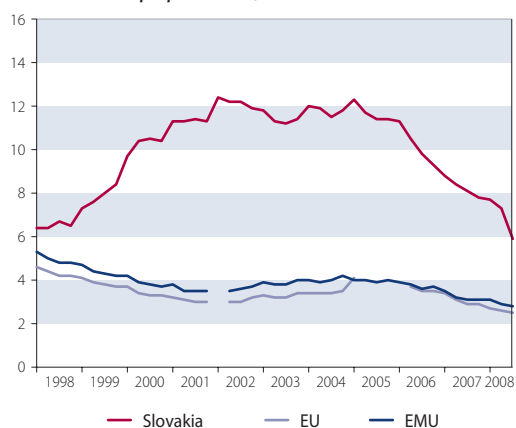
The relatively high NAIRU in Slovakia implies that the higher rate of unemployment in the long run was not the result of persistent disequilibrium in the economy, since in that case, under the NAIRU concept, it would also have been reflected in a long-lasting negative output gap and low inflation. The causes of the high unemployment are therefore more structural than cyclical in nature. This assertion is supported by the structure of the unemployed broken down by duration of unemployment. In comparison with the EU and

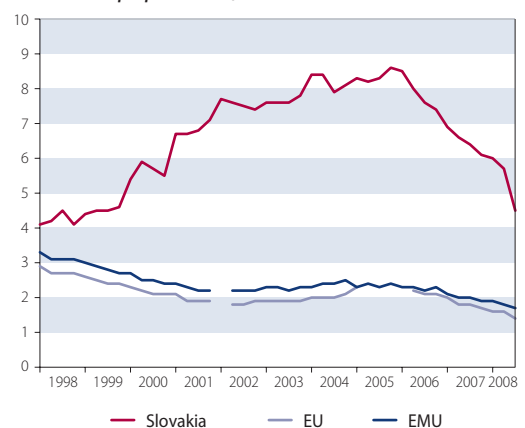**Chart 7 Long-term unemployed (as a % of the unemployed)**

EU (EU-15-2004, EU-25-2006, EU-27) — Slovakia
Euro area (EA) (EA11-2000, EA12-2006, EA13-2007, EA15-2008, EA16)

Source: Eurostat.

Chart 8 Rate of long-term unemployment (as a % of the active population)

— Slovakia — EU — EMU

Source: Eurostat.

Chart 9 Very long-term unemployed (as a % of the active population)

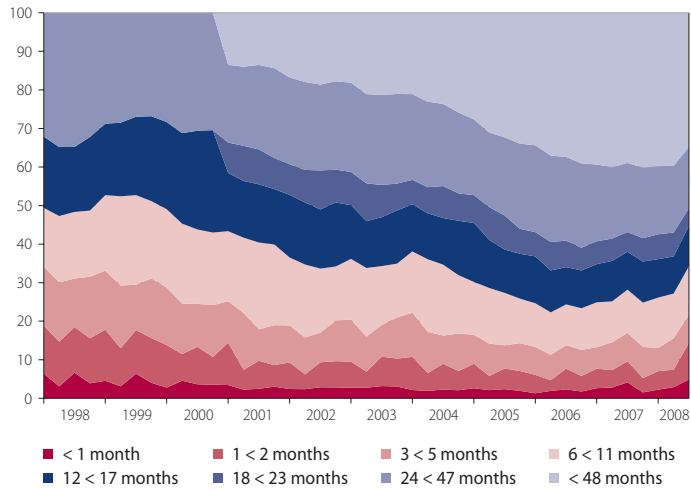— Slovakia — EU — EMU

Source: Eurostat.

euro area, Slovakia has a considerably higher proportion of long-term unemployed (people out of work for more than one year), as shown in Charts 7 and 8. The disproportion in the case of very long-term unemployed (out of work for more than two years) is even more marked (see Chart 9).

A more detailed breakdown of the duration structure of unemployment is given in Chart 10 (data on unemployment spells of 18 to 23 months and more than 48 months have been available only since 2001, and hence the jump in the chart). The decline in unemployment during the dynamic economic growth of recent years led to an increase in the share of very long-term unemployed.

That Slovakia has a higher share of long-term unemployed at the expense of shorter-term unemployed implies that its labour market, in comparison with the EU or euro area, is less flexible and probably includes greater mismatches between
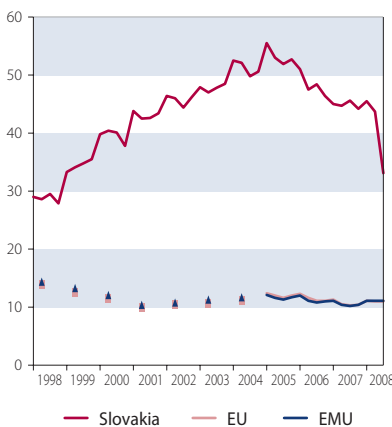
*Chart 10 Rate of unemployment by duration of unemployment (in %)*

Legend: < 1 month, 1 < 2 months, 3 < 5 months, 6 < 11 months, 12 < 17 months, 18 < 23 months, 24 < 47 months, < 48 months

Source: Eurostat and the authors' calculations.

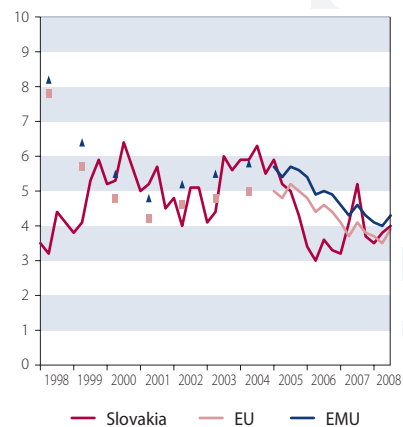*Chart 11 Structure of the unemployed by education (in %)*

a) Pre-primary, primary and lower secondary education – levels 0-2 (ISCED 1997)

b) Upper secondary and post-secondary non-tertiary education – levels 3-4 (ISCED 1997)
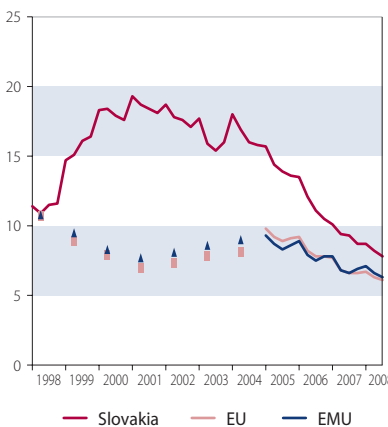
c) Tertiary education – levels 5-6 (ISCED 1997)

Legend: Slovakia, EU, EMU

Source: Eurostat and the authors' calculations.

labour supply and demand. One of the factors characterizing the composition of labour supply is educational structure, as shown in Charts 11a, 11b and 11c. The unemployment rate among economically active people with a tertiary education is comparable to the corresponding rate in the EU and the euro area, but the unemployment rate among working-age people with a primary education is between three and five times higher than the European average. Among people with a secondary education, the unemployment rate shows a gradual decline towards Europe-wide levels, implying that the drop in unemployment during the rapid economic expansion occurred mainly within this segment of the population.

Given the changing structure of the Slovak economy as a result of its transformation to a market economy and FDI inflows, it would be useful, when assessing the mismatches between supply and demand in the labour market, to see the unemployment structure broken down by

the previous occupation of the unemployed. Although such data are available from the Eurostat database, they lack high information value since the vast majority of respondents did not answer the respective question.

CONCLUSION

The estimates of the NAIRU in Slovakia imply that the historically high level of unemployment is more structural than cyclical in nature. The NAIRU in Slovakia is higher than in most other EU or OECD countries, indicating that the structural mismatches between labour demand and supply are relatively more pronounced here. The assumption that the Slovak labour market is relatively more inflexible is supported by the comparison of unemployment structure in terms of the duration of unemployment, and not only by the fact that the dynamics of the equilibrium number of employed persons increasingly lagged the economy's sustainable growth during its recent period

of acceleration. The proportion of long-term unemployed is substantially higher in Slovakia than in the euro area or the European Union, where the predominant length of unemployment is less than one year.

As far as monetary policy is concerned, the estimated NAIRU is an indicator that helps provide a picture of the economy's cyclical position, which may prove useful for the stabilizing setting of policy instruments. The deviations of unemployment from the NAIRU range (particularly from its narrow version abstracting from the results of pure statistical approaches, which in the long run tend to remain close to the actual data) provide information about periods of labour market disequilibrium. In order to ensure the sustainable reduction of unemployment that has a predominant structural component, it is necessary to carry out reforms that increase the labour market flexibility and labour force skills, since this could mitigate undesirable deviations of unemployment from the equilibrium.