The impact of the global economic and financial crisis on the potential GDP

Juraj Huček, Branislav Reľovský, Jana Široká*

Introduction

The global economic and financial crisis that fully affected all parts of the world in 2009 resulted in most countries, including Slovakia, in a sharp drop in gross domestic product (GDP). Despite the present recovery of economic activity, the level of production lags far behind the pre-crisis period, and it is expected that GDP will not return to pre-crisis levels before 2011. In terms of estimating potential output, standard statistical approaches are unable to properly absorb such a sharp drop in GDP and so any estimates can be greatly distorted. The Medium-Term Forecast of the Národná banka Slovenska of March 2010 (referred below as MTF-2010Q1) assumed, in line with available data, that the decline in GDP reduced only the potential output growth, not its level. Such an estimate may not have appeared unreasonable; however, it gave the opportunity for potential conflict between the forecasted development in the output gap and forecasted prices. While production was forecast to remain under the potential output level over the whole forecast period (until 2012), price developments in the form of gradually accelerating inflation did not reflect this fact. However, a number of countries are exposed to analogous conflicts between prices and the output gap, and presently there are insufficient analyses and information available to reliably explain the aforementioned phenomenon.

An analysis of the current global economic and financial crisis raises a wide range of questions that often focus on two major themes. The first involves an examination of whether the consequences of the crisis, i.e. GDP losses and/or the decline in the global economy are permanent, or, can be recovered within a couple of years. It appears from GDP developments during 2009 that in a number of countries the output gap deepened considerably and restoring equilibrium in economies (i.e. attaining their potential output levels) will require strong GDP growth dynamics, which cannot be expected in the short-term. In this respect, the present crisis is often associated with a "crisis of confidence" and/or "crisis of demand" concepts. The question is whether the current crisis can simply be regarded as a crisis in demand which had no impact on the supply (i.e. the potential output) side of the economy, whereupon the levels anticipated prior to the crisis will soon be reached. However, the persisting negative output gap raises a second type of question – the conflict between the view of the cyclical position and expected development in prices. The latest estimates of the output gap are often contrary to price developments; the decline in GDP is not fully reflected in inflation/deflation. Under standard assumptions of the link between the cyclical position and inflation, it could be expected that there is still considerable room for price drops, although there are no such indications either in the actual or forecasted data.

This paper **aims** to provide insight into present developments in the potential output of the Slovak economy, within the context of the global economic and financial crisis. Given the fact that potential GDP is immeasurable, the factors limiting its estimation are the very approaches used for the calculation of potential output and the output gap. Although we are aware of the fact that the relative shortness of time seriesspan for currently available data can later modify the overall view of current developments, the period relevant from the point of view of policy implications is always the current one. We will try to eliminate this problem by using the latest available forecasts and extrapolated data, and by applying a number of approaches in order to analyse their sensitivity to a decline in actual GDP. This should ultimately help us improve our estimate for potential output even in this non-standard period. The presented analysis is based on assumptions used in the MTF-2010Q1 forecast.

The paper is structured into three chapters. The first chapter reports how the impact of the crisis on the potential GDPs of euro area countries is perceived by the European Commission. Additionally, at the same time, attention is paid to the interrelation between the cyclical position and price developments. The second chapter discusses whether the uncertainty regarding future GDP development can affect the estimate of the cyclical position and/or potential output during the crisis. This part of the analysis makes use of simple statistical approaches applied on extended GDP time series with the aim of eliminating the end-point problem. The third chapter provides a detailed analysis of the scope for a possible decrease in potential GDP through production factors. Two analytical instruments (the multivariate filter with unobserved components and the structural econometric model of the Slovak economy) are used to identify and quantify possible discrepancies between economic activity and price development within the MTF-2010Q1 forecast. These instruments also assess a proposed scenario for potential output development in which the relationship between the cyclical position of the economy and its price development is brought closer to the links defined by economic theory and, consequently, provide a new view of the output gap development.

1. Impact of the crisis on potential GDP in euro area countries

As a result of the global economic and financial crisis, in 2009 the economies of all euro area countries fell into recession. This development was reflected not only in GDP, but also by other indicators such as employment rates and consumer prices. Despite the considerable declines in GDP, the European Commission[1] believes that the development of potential output in most countries experienced only a slowdown in growth without any so-called level shift[2]. The exception among euro area countries is Ireland, in respect of which the European Commission expects that potential GDP will keep decreasing not only in 2009 but also in 2010.

Chart 1.1: Potential GDP dynamics in the euro area
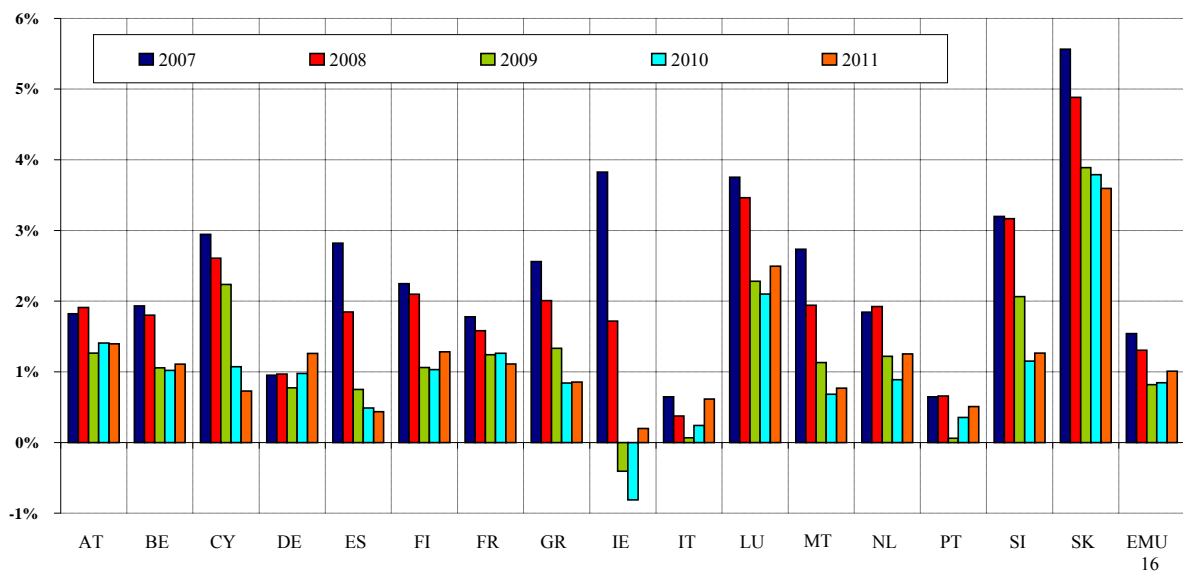
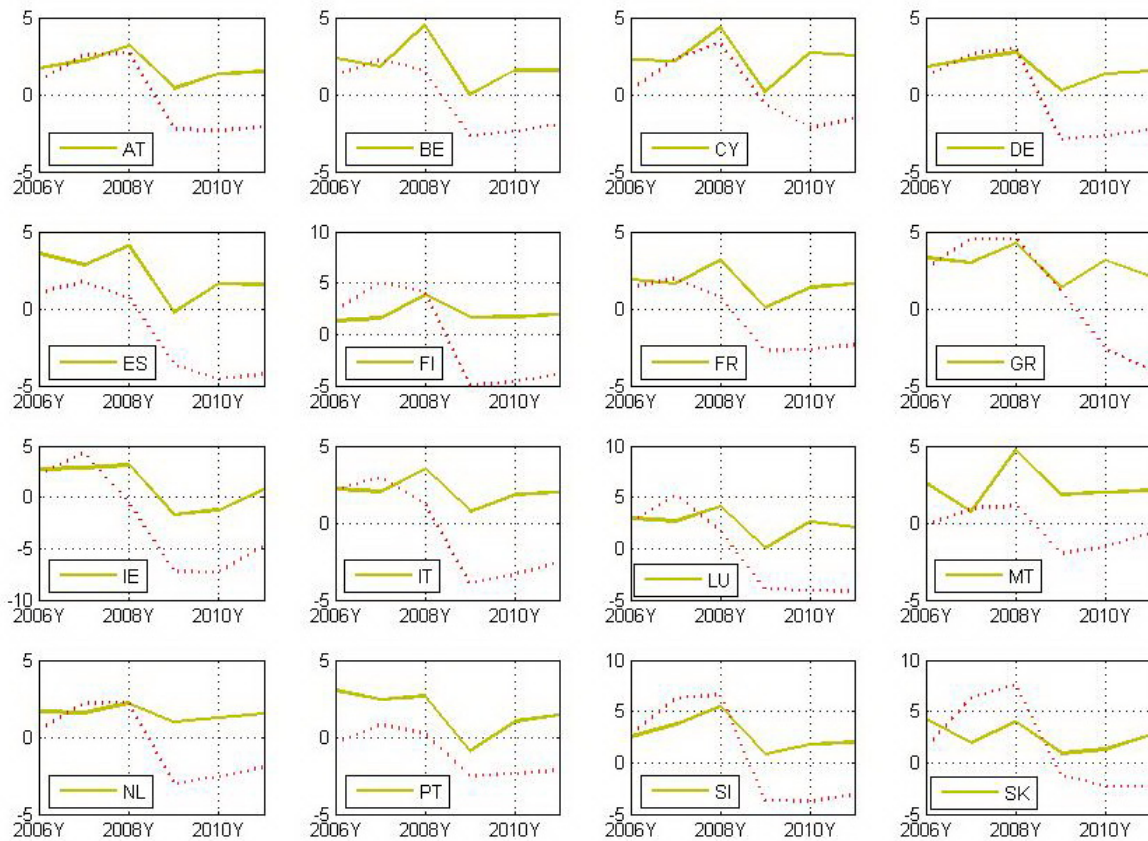**Source:** The European Commission

This view of the potential output in individual countries, however, raises valid doubts concerning the interrelation between developments in consumer prices and the output gap as defined by standard economic theory. While the European Commission estimates a negative output gap for all euro area countries (except Greece) from 2009 to 2011, in price development this fact is only reflected in 2009. This is because most countries expect inflation to accelerate as early as 2010. Under the standard assumed relationship between prices and economic activities (Phillips curve), a negative output gap should have a reducing effect on prices; however, in fact this development is not reflected in individual price forecasts of individual economies. Although in 2009 all countries experienced a considerable slowdown in inflation, which appears in line with the negative output gaps in the respective economies, it should be noted, however, that in addition to low demand, this development was to a large extent influenced by other factors, mainly by the drop in commodity prices.

---

[1] For the purpose of this analysis, the data of potential GDP and the HICP inflation rates of euro area countries were taken from the EC AMECO database (latest update on 20 April 2010).
[2] Available methods of reflecting the crisis on potential output are summarised in Box 1.

Source: The European Commission

It appears from Chart 1.2 that, based on the European Commission forecast, from 2010 there is only a weak reflection of the negative output gap on prices in Slovakia and other euro area countries. That creates room for discussion regarding the internal links between forecasts, mainly those links between price developments and cyclical positions. A comparison of countries shows that despite the slowdown in Slovak potential output during the crisis, its forecasted growth in the post-crisis period considerably exceeds the dynamics in other countries. However, the deceleration of potential output being considered is not sufficient to close the negative output gap. In the MTF-2010Q1 forecast this issue is even more acute than the forecast of the European Commission. The MTF-2010Q1 forecast states that owing to the relatively high growth of potential output, the output gap will persist with extremely negative values (almost -6 %) until 2012. In both cases, such development indicate that the economy could get closer to restoring its equilibrium solely as a result of stronger demand incentives (which would fully eliminate the reported decline in foreign demand forin 2009); nevertheless, none of the institutions assume the emergence of such an incentive within the forecasted period. A resolution of this issue might lie in a reassessment of potential growth aiming to achieve lower values, which could eliminate the stress between the cyclical position and inflation. A detailed analysis of possible impacts of the crisis on potential output is provided in the following chapters.

**BOX 1: Level shift vs. deceleration of potential output**

In terms of the possible impact of the crisis on the development of potential output, there are two basic scenarios that enable further classification of developments in potential GDP:

1. The global economic and financial crisis **did not affect** either the level or growth of potential GDP.
    This means that the crisis was exclusively on the demand side. Assuming that the present economic and financial crisis is solely attributable to demand would mean that the level of potential production has not been affected by the crisis at all, and that capacities in the economy will continue to grow at pre-crisis rates. Such a scenario, however, involves a considerable decline in the output gap during the crisis. Closing the negative output gap in the following years would require strong GDP growth rates. However, if the actual growth of GDP is insufficient, the capacities of the economy will have been under capacity for a long time and the negative output gap would persist. That would at the same time decelerate price growth.

2. The global economic and financial crisis **affected** the level or growth of potential GDP.
    The sharp decline in the economy combined with the recession is likely to affect not only the demand side of the economy but is also associated with a change in potential output. In such a case there are two options:

2a/ Decline in potential output (i.e. level shift) during the crisis
   i.   It is expected that, in time, the economy will restore the initial level of potential output;
   ii. The economy is not expected to restore the initial level of potential output and in the following years potential output is expected to grow at a rate similar to the pre-crisis rate;
   iii. The economy is not expected to restore the initial level of potential output, and in the following years potential output will continue growing at a slower rate.

Chart B1.1: Level shift
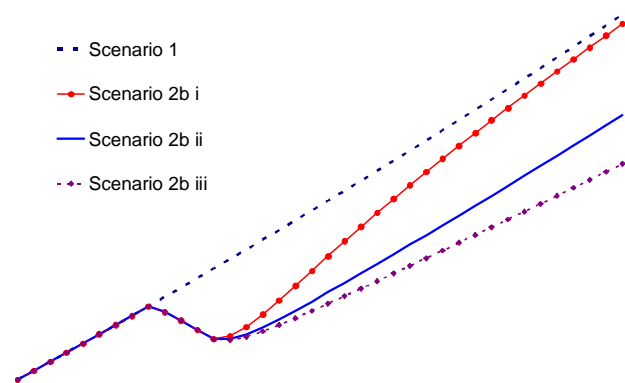
Source: Own calculations

2b/ Deceleration in the growth of potential output during crisis
   i.   It is expected that, in time, the economy will restore the initial level of potential output;
   ii. The economy is not expected to restore the initial level of potential output, and in the following years potential output is expected to grow at a rate similar to the pre-crisis rate;
   iii. The economy is not expected to restore the initial level of potential output and in the following years potential output will continue growing at a slower rate.

Chart B1.2: Deceleration of potential production
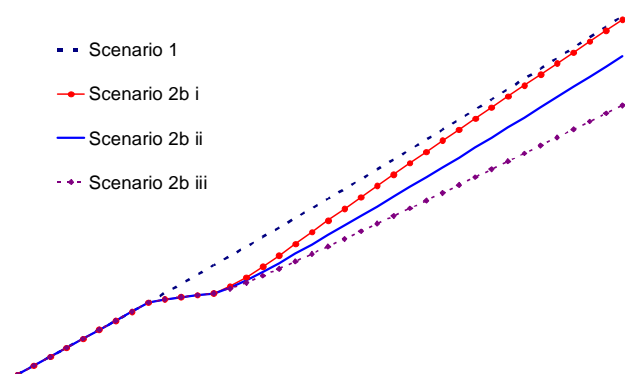
Source: Own calculations

2. Potential output estimated using statistical methods

The existence of close connections between potential GDP and developments in GDP is beyond any doubt. Discussing the optional aspects of potential output without a basic knowledge of GDP developments is of no particular use. That is why the beginning of this chapter is dedicated to the possible, simplified, and most likely future developments in GDP. We will try to ascertain whether the extension of the forecasted period makes sense in terms of estimating potential GDP, and whether it provides any insight into GDP development that is different than the present view of GDP developments for the current period affected by the economic crisis.

Currently it is clear that there was level shift of the GDP level, however, future development remains questionable. Our simplified scheme provides three GDP development scenarios for the following years:

Scenario 1: The huge drop in GDP was temporary and the economy will shortly return to the initially expected production levels (the so-called transitory change – TC) – see Chart 2.1;

Scenario 2: The economy will never return to the initial trajectory of production capabilities and in the post-crisis period will grow at rates similar to the pre-crisis rates (the so-called "level shift" – LS) – see Chart 2.2;

Scenario 3: In the post-crisis period the economy will grow at slower rates – see Chart 2.3.

Potential GDP can be estimated using several methods - from simple statistical approaches without additional economic links, to comprehensive models with sufficient economic information about the crisis and/or radical changes in data. Methods based exclusively on the mechanical filtration of GDP often serve as the preliminary estimate of potential. Although these approaches mostly result in estimates which are distorted and suffered the end point problem, from the historical perspective they provide sufficient information about the potential output position.

Potential output is immeasurable, in equilibrium and therefore, in a sense, it is a long-term variable not expected any disturbances, i.e. it should (in parts) be stable. Conflicts with this very simplified definition occur when the underlying data include non-standard changes or structural break, and future development is uncertain. In such a case, the application of statistical methods or simple models to estimate potential the condition of stability is not fulfilled. This means that if we are unable to properly identify the type of structural break in the underlying data, or if a problematic period is still pending, without additional information and expert intervention we are unable to estimate potential output properly. Alternative scenarios of GDP developments could, in a way, help identify the problematic crisis period and enable the use of simple statistical approaches to localise potential output.

We used two simple statistical approaches (HP filter with a lambda value of 1600, and the asymmetric Christiano-Fitzgerald band-pass filter) to verify whether future developments in GDP have an impact on the estimated cyclical position in the crisis period. The approaches were applied to all three applicable scenarios of GDP development.

Based on the results from the HP filter, it can be concluded that the pre-crisis period could be assessed as substantial overheating and the post-crisis period assessed as pronounced overcooling. The HP filter did not identify any radical change in the level of potential output in any of the three scenarios of GDP development. In contrast, the band-pass filter reflected almost the full extent of the crisis in the potential output level (level shift) in Scenarios 2 and 3, while the cyclical position did not experience any substantial fluctuations. A decline in potential output was observed under Scenario 1 as well, although it did not reach the extent observed under Scenarios 2 and 3. This means that the amount of decline depends on how long it takes until GDP is restored to its initial level (the shorter the period of recovery, the lower the decline). Thus, in potential output terms, the two simple approaches provide different solutions. The reason for the different results is of a purely methodological nature. While the HP filter is designed to highlight the smooth development of the trend, the band-pass filter highlights the smooth course of the cycle.

Chart 2.1: Potential GDP and the output gap in the event of GDP's early restoration to pre-crisis levels – comparing the HP filter to BP filter
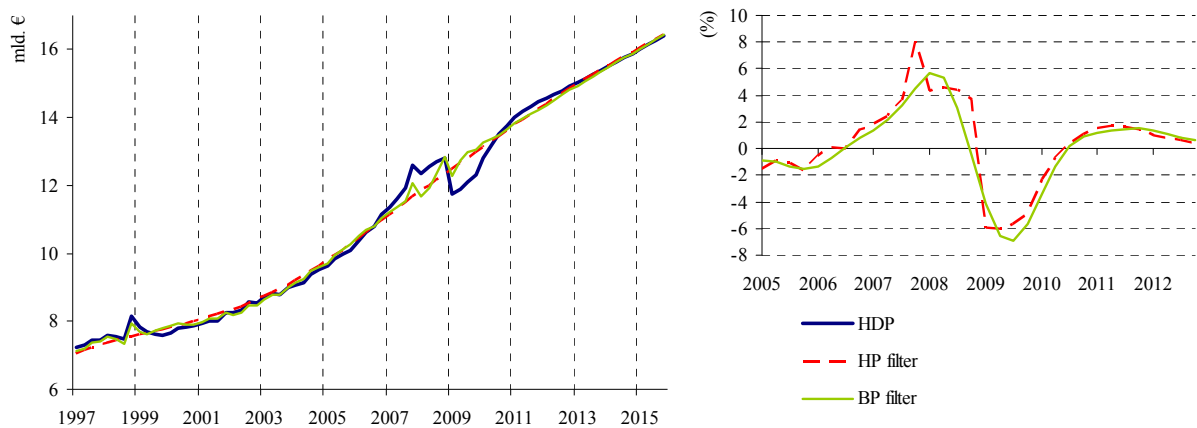
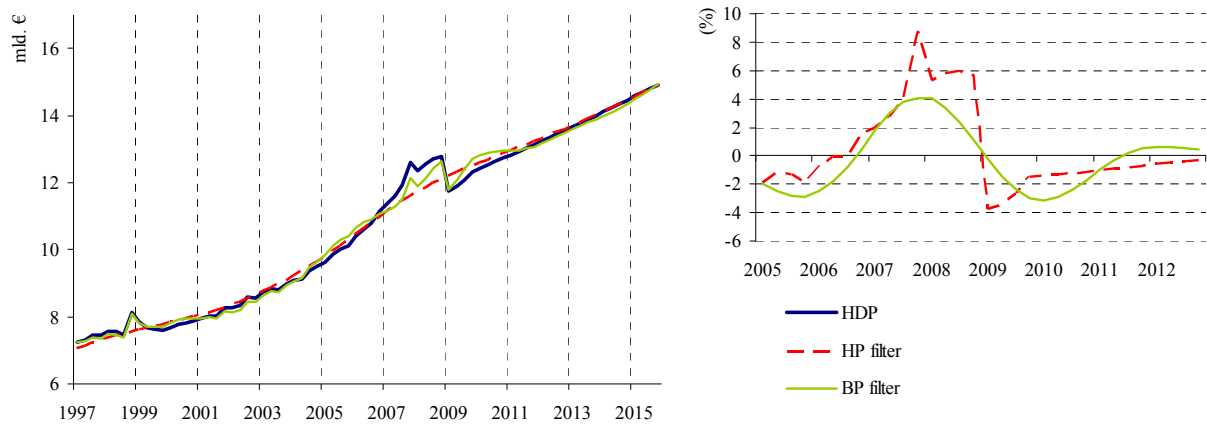**Source:** The Statistical Office of the Slovak Republic and own calculations

Chart 2.2: Potential GDP and the output gap in the event of continued GDP growth at pre-crisis rates - comparing the HP filter to the BP filter
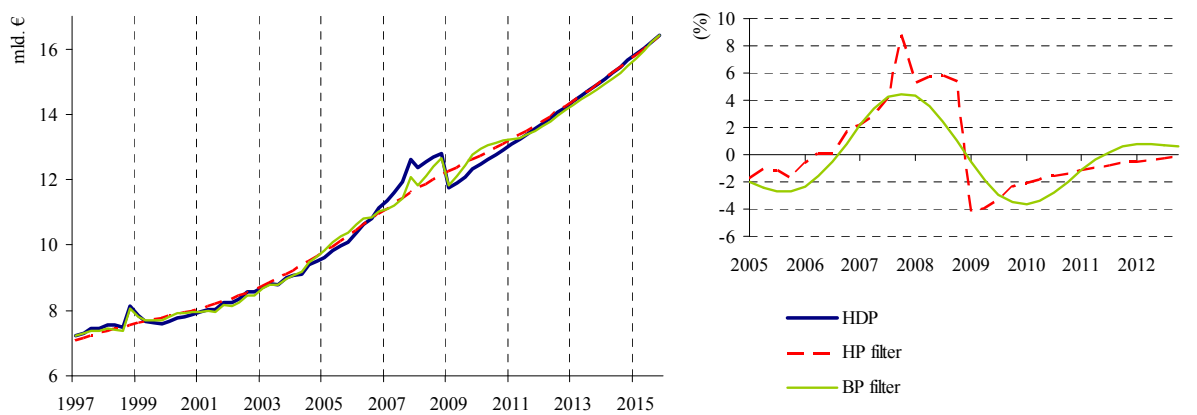
Source: The Statistical Office of the Slovak Republic and own calculations

Chart 2.3: Potential GDP and the output gap in the event of GDP growth at slower than pre-crisis rates - comparing the HP filter to the BP filter

Source: The Statistical Office of the Slovak Republic and own calculations

The aforementioned analysis indicates that to estimate potential output, and to identify the cycle correctly using simple statistical approaches, it is not enough to extend the time series. Not only do individual methods provide different views of potential output and the output gap, but under the most likely scenarios of economic development the method used provides an unchanged view of potential output. The final figure of the potential output strongly depends on the applied method. Therefore, in the case of crisis, it is necessary that potential output is estimated using methods with economic links, that consideration be given to alternative cyclical position indicators, and finally that a view of the output gap is chosen which would not be contrary to the aforementioned indicators.

3. Economic discussion and interpretation of different methods to reflect the crisis in potential output

The above text discussed two types of uncertainty that need to be addressed when analysing present economic developments. The first uncertainty refers to how the economic and financial crisis affected the supply side of economy, i.e. its *potential performance*. The second uncertainty refers to the ability of *the actual performance* to recover from the crisis. Given the size and openness of the Slovak economy, a simplified assumption can be made that its actual performance in the short-term will be determined by trends in its own potential output to a much lesser extent than trends in demand from foreign business partners. Then, with an unavoidable degree of simplification, the uncertainty regarding developments in actual GDP within 2 – 3 years can be eliminated in the following text by assuming that it will be consistent with the expected revival of growth in foreign demand (in line with assumptions of the MTF-2010Q1 forecast), and, in fact, independent of the trajectory of potential output. This means that **the following text takes developments in actual GDP for the next 3 years as given, and we will try to answer the question of how to address the uncertainty in respect of potential economic performance during that period using a method that is construable in economic terms and minimises discrepancies in the relationship between the cyclical position and price development**.

Chart 3.1 indicates the trajectory of actual GDP in line with the MTF-2010Q1 forecast, with three proposed scenarios for development in potential output. A and B options are motivated by Chapter 2, with A being analogous to a decline in potential output (as indicated by the band-pass filter) and B referring to a slowdown of potential growth already in the pre-crisis period (in line with the results of the HP filter). The C option represents the NBS's approach in accordance with the MTF-2010Q1 forecast, under which the view of potential output in the pre-crisis period is not affected by a decline in economic activity, while during the crisis and post-crisis periods potential growth is slower.

Chart 3.1: Options of reflection of the crisis in the trajectory of potential output

EUR mil.

- GDP according to the MTF-2010Q1 forecast
- Option A: Level shift of potential output
- Option B: Slowdown of potential output in pre-crisis period
- Option C: Slowdown of potential output in the post-crisis period
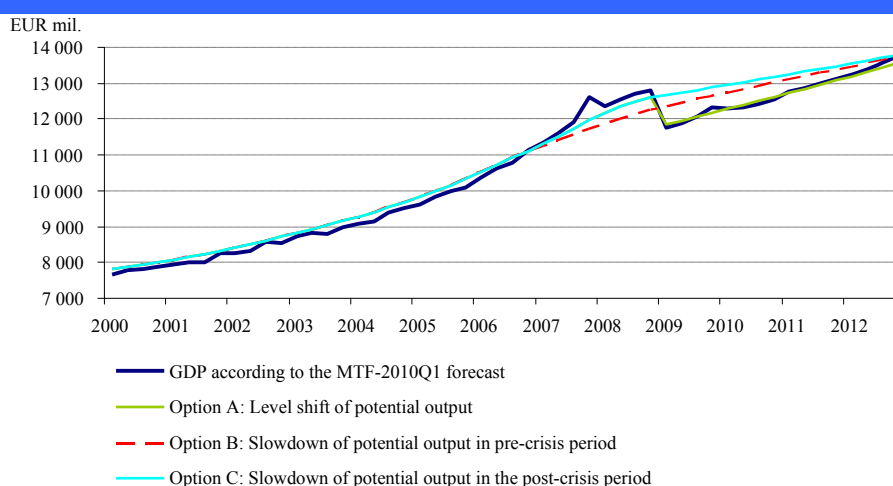
Source: The Statistical Office of the Slovak Republic and own calculations

Option A

Option A is the only one of the three proposed options involving a level shift of potential output as a result of the crisis. It indicates that the economic and financial crisis affected in a similar way (though to a possibly different extent) both demand and supply sides of the economy. It assumes that both sides experienced a decline during the crisis. From a methodological point of view, this option can be supported by a simple statistical approach in the form of band-pass filter, which – aiming to minimise fluctuations in cyclical component – attributes almost the full amount of the structutral break in actual GDP to estimated potential output. Among euro area countries, the European Commission applies a similar method of reflecting the crisis in potential output (i.e. the level shift) to Ireland (see Chapter 1).

The economic interpretation of option A is slightly problematic in terms of the Slovak economy. To give its consideration a reasonable basis, the drivers of the decline in potential output would need to be specified.

The standard approach to quantification of potential output is the two-factor production function, based on two production factors (labour and capital) and the total factor productivity (TFP). Therefore, if the economy was to experience a decline in potential output, it would have to be caused by a change (decline) in one of these inputs.

Changes in the capital stock could result from increased depreciation owing to possible restructuring of the economy or a large number of extraordinary write-offs owing to bankrupt companies. However, in Slovakia, there have not yet been any indications of economic restructuring, neither there is information available regarding extraordinary write-offs. The only so far valid consequence of the crisis is the slowdown in the growth of capital stock (compared to previous years) owing to lower investments; however, no decline in the capital stock has been observed.

Potential employment derives from the available labour force and the non-accelerating inflation rate of unemployment (NAIRU). As the impact of the crisis on the labour force should be marginal (e.g. old-age pensioners leaving the labour market having lost jobs due to

the crisis) and the return to Slovakia of redundant employees from abroad is expected to cause only a mild increase in NAIRU, a considerable decline in potential employment appears to be unfounded. Of course, if the problems on the labour market persist and unemployment spells become longer, the loss of work habits and the increase in the long-term unemployment may result in the stronger growth of NAIRU. Similarly, it is possible that NAIRU will further increase in the event of economic restructuring as a result of growing structural unemployment and inadequate qualification profiles of job-seekers in the economy focused on other industries.

As to TFP, the crisis undoubtedly slows the pace of technological progress. Lower R&D expenditures combined with reduced investment in new technologies hamper growth in the overall productivity of production factors and may cause technologies to stagnate. However, justification of a substantial decline in the total factor productivity would again require an obvious restructuring of the economy followed by reallocation of resources from high-productivity to low-productivity sectors, which has thus far not been a characteristic of the Slovak economic environment.

Option B

Similarly to option A, from a methodological point of view, option B is also supported by a simple statistical approach – the HP filter. It indicates a slowdown in potential growth already a couple of years before the crisis, which results in major overheating in the pre-crisis period and a strikingly negative output gap both during the crisis and in the post-crisis period. In the EC forecast, Slovenia and Finland may serve as examples of application of such an approach to reflect the economic crisis in potential growth (see Chapter 1). In Slovakia, this approach is advocated by the Ministry of Finance of the Slovak Republic (MF SR). In its latest macroeconomic forecast dated February 2010, the Ministry describes the cyclical position of the Slovak economy in line with Table 3.1.

Table 3.1: Cyclical position according to the MF SR (February 2010)

|	Actual		Forecast				
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Output gap (%)	1.4	3.3	-3.8	-3.2	-2.4	-1.3	-0.6
Potential growth of GDP (%)	7.3	5.1	2.1	2.0	2.5	3.3	3.9

Source: MF SR

Table 3.1 indicates that in the pre-crisis period the Slovak economy should have been in the phase of overheating of the magnitude approximately equal to the magnitude of the post-crisis negative output gap[3]. Such a statement constitutes a remarkable change in perspective on the cyclical position of the Slovak economy in 2007-2008, and the existence of arguments supporting such an opinion need to be examined.

In 2008, both the MF SR and the NBS estimated the cyclical position at approximately zero output gap. It was assumed that these estimates of cyclical developments were in line with price growth, current account deficit, capacity utilisation in the economy, and labour market developments. The fact that the aforementioned indicators experienced either no or only minor revisions raises the question as to whether, at the moment of declaring equilibrium economic development, the aforementioned indicators were really consistent with the published cyclical position and, if not, whether they can be regarded as consistent with such strong overheating as intended by the MF SR.

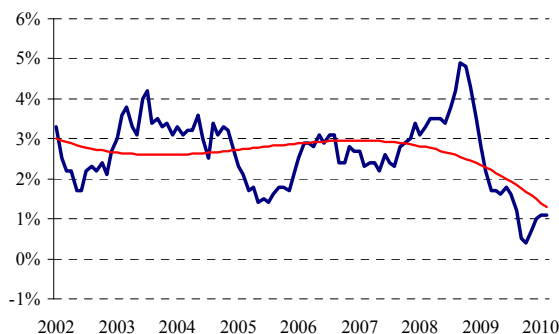**Chart 3.2:** Net exports, current prices, % GDP (thin line - simple polynomial trend)
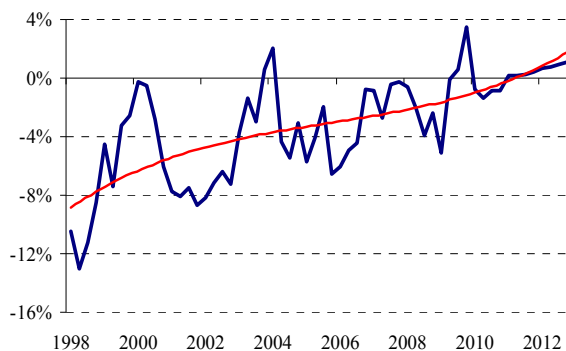
Source: The Statistical Office of the Slovak Republic

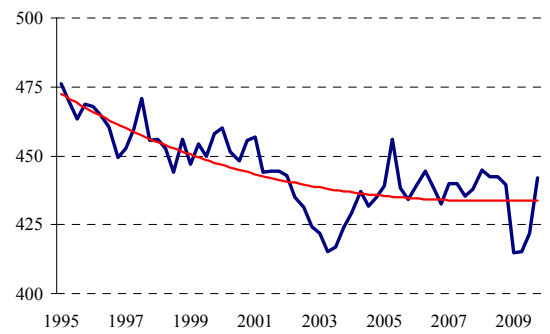**Chart 3.3:** Current capacity utilisation (thin line - simple polynomial trend)
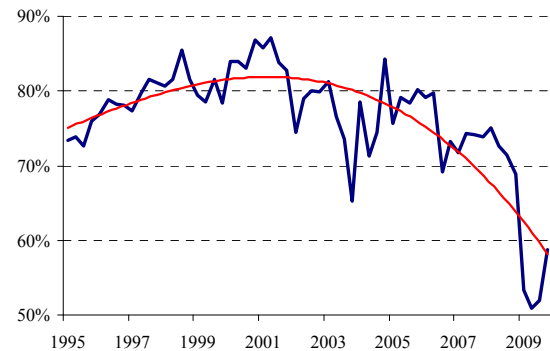
Source: The Statistical Office of the Slovak Republic

Chart 3.4: Net inflation, year-on-year change (thin line - simple polynomial trend)

Source: The Statistical Office of the Slovak Republic

Chart 3.5: Hours worked per employee (thin line - simple polynomial trend)

Source: The Statistical Office of the Slovak Republic

---

[3] In March 2010, the Ministry of Finance of the Slovak Republic prepared an economic analysis that presented an alternative estimate of the output gap. In this analysis, the magnitude of the pre-crisis overheating is considerably lower than the size of the negative output gap in the crisis and post-crisis periods (2007: 1.7%; 2008: 1.8%; 2009: -4.9%; 2010: -3.3%; 2011: -3.2%; 2012: -2.7%; 2013: -2.2%). The document is available at: http://www.finance.gov.sk/Default.aspx?CatID=7541.

Charts 3.2-3.5 do not provide sufficient arguments to support the pre-crisis overheating of the Slovak economy of a size exceeding 3%. The foreign trade balance is far from the levels reported in the nineties, when the Slovak economy experienced its only clear historical phase so far of massive overheating. Capacity utilisation in the pre-crisis period shows the economy's potential to produce above the current output level, which is most likely attributable to the fact that the newly built car manufacturing plants started up production gradually at that time and did not work at full capacity right after launching production. On the other hand, developments in net inflation indicate the existence of inflationary pressures in the pre-crisis period, while their size was even curbed by significant appreciation of the exchange rate of the Slovak koruna at that time. Contrary to that, the developments on the labour market do not confirm an overheating, as the number of hours worked per employee more or less stagnated from 2005 to 2008.

Option C

Option C is consistent with the approach applied by the NBS in estimating the cyclical position of the Slovak economy as published in the MTF-2010Q1 forecast. The MTF-2010Q1 forecast did not provide any substantial revision compared to the previous forecasts of the view on the output gap in the pre-crisis period, as it still characterized the years 2007-2008 by mild overheating. The forecast assumed a minor[4] slowdown of potential growth during the crisis, which was expected to continue in the post-crisis period, thus enabling a very slow closing of the output gap through real GDP growth rates exceeding potential growth. Option C is similar to the approach adopted by the European Commission in reflecting the crisis on the supply side of the economy, for instance, in the Spanish and Portuguese economies (see Chapter 1).

Option C defines the pre-crisis period as a period of mild overheating, the magnitude of which should be consistent with the aforementioned cyclical position indicators (current account, inflation, capacity utilisation, etc). However, the trends in net inflation[5], mainly in 2008, indicate that the economy might have been overheating more during that period. Nevertheless, it appears that the magnitude of overheating should not exceed the magnitude of the post-crisis negative output gap.

Table 3.2: Cyclical position according to the NBS (MTF-2010Q1, March 2010)

	Actual			Forecast		
	2007	**2008**	**2009**	**2010**	**2011**	**2012**
Output gap (%)	1.4	1.5	-7.7	-6.4	-5.7	-5.8
Potential growth of GDP (%)	8.1	6.1	4.8	1.8	3.6	4.3

Source: NBS

---

[4] The slowdown was weak given the actual developments in GDP.

[5] A major factor that needs to be mentioned in connection with price development is the strong appreciation of the exchange rate of the Slovak koruna in 2008, which did not seem to be reflected in the inflation rate. It appears that this was due to the fact that the impact of relatively strong appreciation was offset by the positive output gap.

On the other hand, a major problem brought to the fore by option C is the opening of a large negative output gap in the crisis period, and its impact on price development in the medium term. Assuming no changes in price sensitivity to the cyclical position, the long-term negative output gap is expected to cause long-term deflationary pressures in the economy, which, however, were not reflected in the MTF-2010Q1 forecast. In other words, in terms of standard economic theory, the MTF-2010Q1 forecast involves an internal conflict between the cyclical position and price development. To be more specific, it means that the MTF-2010Q1 forecast:

- overstates inflation in relation to the forecasted output gap, or
- assumes a disproportionately deep negative output gap in relation to the forecasted inflation, which can be caused either by
  - overstating potential growth, or by
  - understating real GDP growth.

Along with the issue of discrepancy between the cyclical position and price development, option C introduces another disputable fact – in order to close the negative output gap, real GDP has to grow faster than potential output for a considerable length of time. Therefore, the following text aims to specify the origin of the aforementioned problems and to outline their possible resolution using analytical instruments.

Elimination of conflicting developments in the output gap and inflation in the medium-term forecast MTF-2010Q1

Despite the significant negative output gap, the medium-term forecast (MTF-2010Q1) assumes that in the next 2-3 years the Slovak economy will experience a relatively dynamic price development accompanied by economic growth which should be far and away the best in the euro area. However, the dynamic revival of the economy in combination with a non-closing output gap, which is in addition associated with relatively strong inflation (in relation to cyclical position), requires an assessment of the scope of the implicit conflict between the aforementioned variables in the forecast and designing applicable solutions for its elimination. For that purpose, in the following text, two analytical tools have been used – a multivariate filter with unobserved components (MV-UC)[6] and a structural econometric model of the Slovak economy[7].

Both tools confirm the existence of the above indicated discrepancy in the MTF-2010Q1. The MV-UC model uses inflation as an exogenous input and therefore identifies the *output gap* as being incorrectly projected. On the other hand, the structural model, which is used for simulating the economy with a given output gap, defines the *price development* as being incorrectly projected. As follows, both tools indicate the same problem (the discrepancy between inflation and cyclical position), although each from a different perspective. The origin of the conflict is always traced to such an indicator which is endogenous to the model used (i.e. which is not defined as an exogenous variable).

---

[6] A detailed description of the model is provided in the NBS paper *Estimating the NAIRU in the Slovak economy* published in October 2009, which is available at:
 http://www.nbs.sk/_img/Documents/PUBLIK/MU/NAIRU.pdf.
[7] Reľovský, B., Široká, J.: A structural model of the Slovak economy, Banking Journal BIATEC, Volume 17/2009, No. 7, pages 8-12.

BOX 2: Multivariate filter with unobserved components: **looking for the optimum level of potential output in the context of the MTF-2010Q1 forecast**.

In the forecasting process, the model with unobserved components using a Kalman filter (MV-UC) is employed to estimate the current position of the Slovak economy. Variables such as potential GDP or potential employment, as well as the cyclical components of GDP and labour, are the main outputs from the model and at the same time serve as inputs for the structural model. The MV-UC model includes three basic economic links – Phillips curve, IS curve, and the Cobb-Douglas production function. The identical specification of key equations guarantees a logical interconnection with the structural model (designed mainly for predictions and simulation of possible shocks hitting the economy).

For the purpose of the analysis aimed to localise the potential GDP on the forecast horizon, the historical MV-UC database was extended by the MTF-2010Q1 forecast, i.e. it was assumed that the forecast would be accurate. As the GDP, employment and inflation represent the exogenous inputs for the MV-UC model, the model aims to find such levels of potential GDP and potential employment which, via the resulting output gap, do not create disproportionate inflationary pressures in the economy, i.e. such levels of potential GDP and potential employment (as well as NAIRU) that are consistent with current and projected inflation.

The comparison of the output gap from the MV-UC model to that from the MTF-2010Q1 forecast indicates the overstatement of the potential GDP in the forecast. Under the MV-UC model, low inflation rates in 2009 indicate the slowdown of potential output as early as in the end of 2008 and, consequently, also its lower levels compared to the MTF-2010Q1 forecast. **All in all, the MV-UC model shifts NAIRU to higher levels, slows down the growth of potential output and, consequently, accelerates the closure of the output gap.** To enable potential output to reach the level equal to the MTF-2010Q1 medium-term forecast, inflation would have to be considerably lower.

Table B2.1: Comparing MTF-2010Q1 to MV-UC results

|	Output gap (%)			Potential growth of GDP (%)			NAIRU (%)		
	MV-UC	MTF-2010Q1	Difference	MV-UC	MTF-2010Q1	Difference	MV-UC	MTF-2010Q1	Difference
2007	1.0	1.4	-0.5	8.3	8.1	0.2	11.5	11.3	0.2
2008	1.8	1.5	0.3	5.3	6.1	-0.8	11.4	11.1	0.3
2009	-4.2	-7.7	3.5	1.2	4.8	-3.6	12.0	11.2	0.8
2010	-2.7	-6.4	3.7	1.7	1.8	0.0	13.3	12.1	1.3
2011	-1.8	-5.7	3.8	3.4	3.6	-0.2	13.5	11.9	1.6
2012	-1.1	-5.8	4.7	3.4	4.3	-0.9	13.6	11.6	2.0

Source: NBS and own calculations

Chart B2.1: Output gap
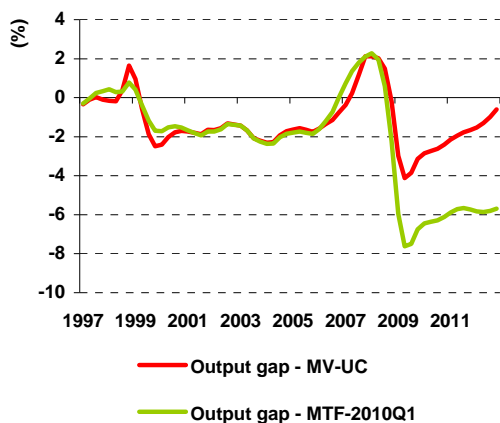
Source: NBS and own calculations

Graf B2.2: Unemployment rate and NAIRU
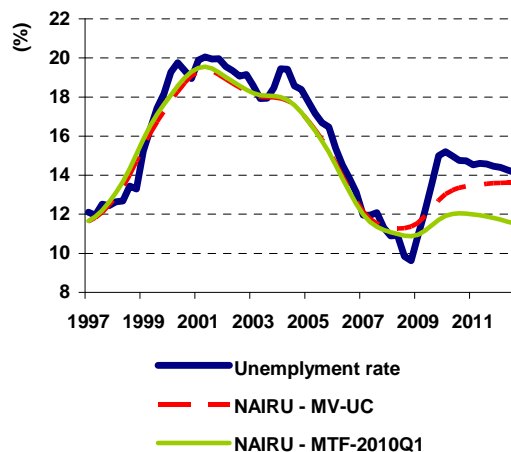
Source: NBS and own calculations

BOX 3: Structural econometric model: **looking for the optimum price development in the context of the MTF-2010Q1 forecast**.

The structural model of the Slovak economy is used in the forecasting process for creating comprehensive macroeconomic forecasts. The supply side of the economy is described using the Cobb-Douglas production function with the trajectories of most its inputs given exogenously. This applies to TFP, NAIRU, labour force, and depreciation rate. The only partially endogenously calculated input to the production function is the capital stock, which develops consistently with investments generated by the model. Outputs from the model, constituted by a system of econometric equations and accounting identities, are (in addition to other indicators) the actual GDP and the inflation rate.

For the purpose of assessing the consistency of the actual and projected price developments with the estimated cyclical position, the structural model was used to simulate the crisis scenario of a decline in foreign demand and foreign inflation. The shock was sized to be consistent with the observed foreign development in the crisis period – in this way the initial shock which occurs in year 1 was defined (year 1 in the scenario means 2009, in which the crisis became fully evident). In the following years, the model was subject to repeated shocks to foreign demand, aiming to produce such a shift in the output gap compared to the baseline scenario which would be consistent with the MTF-2010Q1 forecast. Thus, the shift in the cyclical position between the baseline and the shock scenarios mirrors the shift in the cyclical position of the Slovak economy from its equilibrium (which could be assumed if there was no crisis) to the negative output gap caused by the crisis as presented by the MTF-2010Q1 forecast. As prices create the only channel through which the economy can accomodate the pronounced demand shock inducing long-term negative output gap, the simulation indicates substantial and persistent deflationary pressures in price development.

Table B3.1: Results of the crisis scenario, difference with the baseline scenario, p.p.

	year 1	year 2	year 3	year 4
Output gap	-7.7	-6.4	-5.7	-5.8
HICP inflation	-2.8	-3.6	-1.9	-2.6

Source: own calculations

Assuming that, had there not been any economic crisis, the Slovak economy would have been in equilibrium (the output gap would have been equal to 0%) and the inflation rate would have reached the assumed equilibrium value of 3% [**], the above simulation of the crisis scenario indicates deflation of -0.6% for 2010 (the 2nd year of the crisis).

Table B3.2: Comparison of the MTF-2010Q1 forecast to the results of the structural model

		2009	2010	2011	2012
Structural model	**Output gap (%)**	-7.7	-6.4	-5.7	-5.8
	HICP inflation (%)	0.2	-0.6	1.1	0.4
MTF-2010Q1	**Output gap (%)**	-7.7	-6.4	-5.7	-5.8
	HICP inflation (%)	0.9	0.7	2.4	2.9

Source: NBS and own calculations

The comparison of inflation indicated by the structural model with inflation as presented in the MTF-2010Q1 forecast points to an overstatement of price development in the forecast. The model simulation indicates that if the conspicuously negative output gap was to persist as in the MTF-2010Q1 forecast, the **inflation development over the whole forecast period would have to be much less dynamic**.

_____

[**] Equilibrium inflation was determined at 3% in line with the long-term trends used by the MV-UC model. It also reflects the long-term average of net inflation in the Slovak economy.

As seen from the detailed information in boxes 2 and 3, both the multivariate filter with unobserved components and the structural econometric model of the Slovak economy indicate that in the MTF-2010Q1 forecast either **the projected inflation should be decreased** or **the closing of the negative output gap should be accelerated**, be it through faster GDP growth or through slower growth of potential output.

Neither the latest domestic price development nor estimation of future price development in foreign countries provides arguments in favour of an extensive downward revision of inflation forecast for the years 2010-2012. Similarly, present foreign demand does not provide any clear incentives to accelerate the real GDP growth. Therefore, it appears that the optimum solution for securing consistency between price development and the cyclical position is a slowdown in the growth of potential output in the crisis and post-crisis periods, which would allow for faster closing of the output gap compared to the MTF-2010Q1 forecast. The slowdown of potential growth in line with the trajectory identified by the MV-UC model is achievable by increasing NAIRU in the forecast period and by a slower growth of TFP. The arguments supporting higher NAIRU include persistent problems on the labour market – stagnation of employment and, consequently, unemployment shifting from short-term to long-term.

For the purpose of assessing the performance of the proposed solution, a structural model was used to simulate a scenario under which the trajectory of the output gap copies the cyclical position of the economy indicated by the MV-UC model. Unlike the simulation described in Box 3, this scenario results in the mitigation of deflationary pressures over the whole forecast horizon.

Table 3.3: Comparison of the MTF-2010Q1 forecast to the results of the structural model

		2009	2010	2011	2012
MTF-2010Q1	Output gap (%)	-7.7	-6.4	-5.7	-5.8
	HICP inflation (%)	0.9	0.7	2.4	2.9
Structural model: gap = MTF-2010Q1	Output gap (%)	-7.7	-6.4	-5.7	-5.8
	HICP inflation (%)	0.2	-0.6	1.1	0.4
Structural model: gap = MV-UC	Output gap (%)	-4.1	-2.7	-1.7	-1.0
	HICP inflation (%)	0.8	0.5	2.5	2.3

Source: NBS and own calculations

Chart 3.6: Output gap (%)

- MTF-2010Q1
- Structural model: gap = MTF-2010Q1
- Structural model: gap = MV-UC
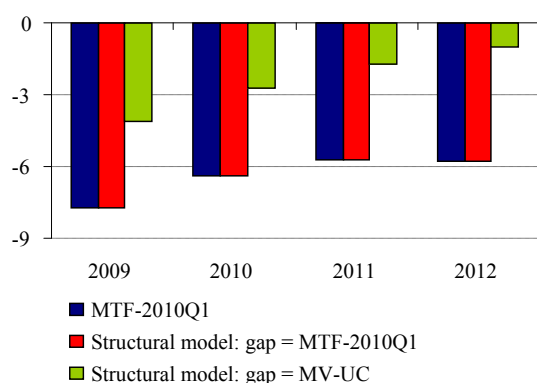
Source: NBS and own calculations

Chart 3.7: HICP inflation (%)

- MTF-2010Q1
- Structural model: gap = MTF-2010Q1
- Structural model: gap = MV-UC
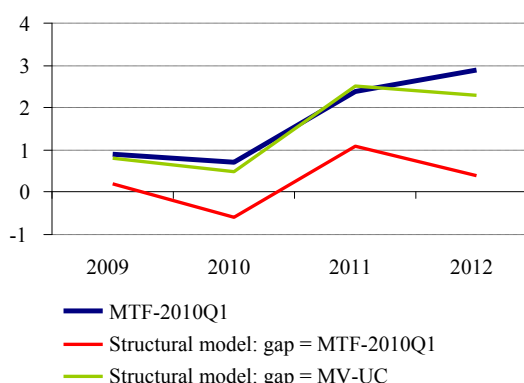
Source: NBS and own calculations

Table 3.3 indicates that the output gap in accordance with the MV-UC model is consistent - in view of the links inside the structural model - with the inflation rates that are very close to the MTF-2010Q1 forecast. Deviations existing over the whole forecast period of 2009-2012 (though mainly in 2012) indicate both the potential existence of other mechanisms which may not be exactly reflected in the structural model, and the fact that the 3% inflation rate may not represent the equilibrium price development in the Slovak economy precisely.

To conclude, it can be stated that the revision of the cyclical position of the Slovak economy in line with the MV-UC model helps to eliminate the tension between price development and the output gap over the whole forecast period, whereas it was not construable in economic terms within the MTF-2010Q1 forecast. The proposal to adopt a new view of the development of potential GDP and the cyclical position does not involve, in the case of updating the MTF-2010Q1 forecast, a need to modify the projection of other economic variables. On the contrary, when modifying the forecast, the reassessment of potential growth and output gap could help to eliminate expert judgements in price development and mitigate the conflict between projected cyclical position and inflation, which was implicit in the MTF-2010Q1 forecast. Compared to the MTF-2010Q1 forecast, the proposed modification would not result in any changes to how the real economy or price developments are viewed.

Table 3.4: Modified MTF-2010Q1 forecast (modified view of the cyclical position)

	Modified MTF-2010Q1 (%)				Difference with MTF-2010Q1 (p.p.)			
	2009	2010	2011	2012	2009	2010	2011	2012
NAIRU	12.0	13.3	13.5	13.6	0.8	1.3	1.6	2.0
Potential growth	1.3	1.6	3.4	3.4	-3.5	-0.2	-0.2	-0.9
Output gap	-4.1	-2.7	-1.7	-1.0	3.5	3.7	3.9	4.8
Growth of GDP	-4.7	3.2	4.4	4.2	0.0	0.0	0.1	0.0
HICP inflation	0.9	0.7	2.4	2.8	0.0	0.0	0.0	0.0

Source: NBS and own calculations

Chart 3.8: Potential GDP according to MTF-2010Q1 and modified MTF-2010Q1 forecasts
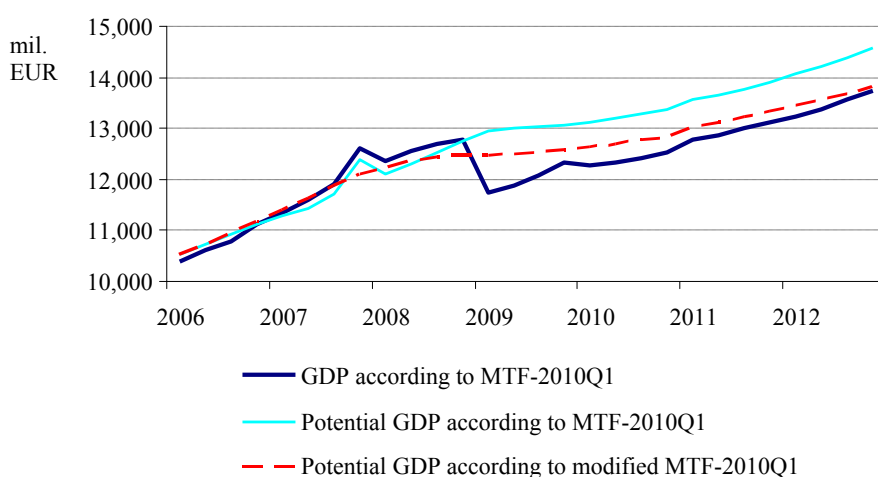
Source: The Statistical Office of the Slovak Republic, NBS and own calculations

Conclusion

The proposed method of reflecting the crisis in the trajectory of the potential output of the Slovak economy, as presented in Table 3.4 and Chart 3.8, is in line with the two aforementioned analytical instruments – the multivariate filter with unobserved components and the structural econometric model of the Slovak economy. The key features of the proposal include:

- the moderate overheating in the pre-crisis period, which, in terms of price development, can be justified by the appreciation of the exchange rate of the Slovak koruna seen at that time,
- the negative (although much less negative than in the MTF-2010Q1 forecast) output gap in the years 2009 and 2010, associated with inflation rates below 1%, and
- the ongoing slowdown of potential growth in the years 2011 and 2012, allowing for a faster closing of the output gap (compared to the MTF-2010Q1 forecast), in combination with a relatively dynamic price development.

The revised view of potential growth and the output gap results in a mitigation of the indicated conflict between the cyclical position and price development, with no changes in the development of the real economy, the prices, or on the labour market (compared to the MTF-2010Q1 forecast).

Given the aforementioned facts, the respective reassessment of the view of potential output and the output gap was incorporated into the latest medium-term forecast MTF-2010Q2. In terms of classifying the initial proposals of methods to reflect the economic and financial crisis in the potential performance of the Slovak economy (see Chapter 3), the approach consistent with option C, which indicated pre-crisis overheating of a substantially lower extent than the subsequent post-crisis negative output gap, is in fact maintained. That, however, is not associated with any decline in the level of potential output. Nevertheless, this analysis does not propose an arbitrary inclination towards the option C; its selection is a result of model calculations and simulations. In a situation where no information or arguments exist (or are available) to support either option A (level shift) or option B (high pre-crisis overheating), the option C is to be regarded as the optimum way to ensure the internal consistency of the forecast. However, given the considerable uncertainty in estimating immeasurable variables in general, and the existence of strong shocks in particular, it is possible that the availability of new information[8] or the nature of future developments will give rise to a need to reassess the interpretation of the impact of the crisis on the potential output of the economy.

---

[8] Information concerning a large amount of extraordinary write-offs in the economy might, for example, make the option of crisis-driven decline in the level of potential production justifiable. However, it should be noted that these write-offs should capture the depreciation of capital in *accounting* terms (actual capital depreciation, reflecting its useful life or usability), not in *tax* terms (enacted capital depreciation, not reflecting its actual useful life or usability).