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Estimating Potential Output and the Output Gap in Slovakia

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European Department

ESTIMATING POTENTIAL OUTPUT AND THE OUTPUT GAP IN SLOVAKIA

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Abstract

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This paper estimates potential output and the output gap for Slovakia which enjoyed rapid growth with few signs of economic overheating in recent years. It applies two broad sets of approaches: conventional methods, represented by a statistical method and a production function approach; and a multivariate (MV) Kalman filter method. The MV Kalman filter method produces estimates of excess demand that portray much more sensibly the situation in recent years in Slovakia than the conventional methods, because it can use more information to condition the paths of potential output.

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I. INTRODUCTION

Slovakia has enjoyed a progressive strengthening of economic growth in recent years. It has become one of central Europe's strongest economic performers. Macroeconomic management has been prudent. A wide range of structural reforms, represented by the labor market reforms during 2003–04 and the introduction of a flat tax regime in 2004, have helped to attract massive foreign direct investment (FDI) inflows. Buoyant investments for the past several years have added to Slovakia's productive capacity and contributed to its strong, export-led economic growth. Despite this rapid growth, little sign of economic overheating has been observed yet. Potential output is likely to have shifted to a higher plateau due to the supply-side impetus of export-oriented FDI projects.

The rapid economic growth with little sign of overheating in recent years raises the question what is the appropriate method to estimate potential output and the output gap of the Slovak economy. Reasonably accurate potential output and output gap estimates are necessary to conduct prudent monetary and fiscal policies. They help in evaluating demand-pull inflationary pressures, as these are most likely to arise when an economy is operating above potential. They also provide a framework for assessing the fiscal stance from the Keynesian point of view that a fiscal expansion (contraction) is desirable when output is below (above) potential. However, it is hard to measure potential output because it is an unobserved variable. The short sample size of the Slovak economy exacerbates the difficulty.² This paper estimates potential output and the output gap for Slovakia using two broad sets of approaches: conventional methods, represented by a statistical method and a production function approach; and a multivariate (MV) Kalman filter method.

Output gaps estimated by the conventional methods do not go well with dynamics of various other economic indicators in recent years in Slovakia. Statistical methods and a production function approach have been widely used to estimate potential output and the output gap. Output gaps estimated by these conventional methods show a large positive swing during 2006–07: a large negative output gap observed in 2005 narrowed sharply in 2006 and turned significantly positive in 2007. However, few signs of economic overheating have been observed yet. The perennial shortcomings of these conventional methods lie in their reliance on statistical detrending of output and inputs, and in their narrow focus on output and input variables. These methods are not appropriate to estimate the output gap in an economy experiencing rapid economic growth driven by a supply-side impetus, like Slovakia.

This paper applies a MV Kalman filter method to estimate potential output and the output gap in Slovakia in an attempt to overcome the shortcomings of the conventional methods. The advantage of this method over the conventional approaches is its ability to

² Reliable national accounts data in Slovakia are available only after 1995.

take into account the economic links between the output gap and other economic indicators. Results given by the MV Kalman filter approach fit the recent dynamics of economic indicators much better than those from the conventional methods. The output gap barely narrowed in 2006 and the size of the positive output gap in 2007 is much smaller than that obtained by the conventional methods.

The remainder of this paper is organized as follows. Section II presents the conventional methods for measuring potential output and the output gap, and discusses the results. Section III provides the MV Kalman filter method and analyzes the estimates. Section IV considers the policy implications of the results given by the MV filter method. Section V gives conclusions.

II. CONVENTIONAL METHODS

A. Statistical methods

Statistical methods provide a straightforward measure of potential output. The Hodrick-Prescott (HP) filter has become the most commonly used statistical method because of its flexibility in tracking the fluctuations of trend output. The HP filter estimates potential output by minimizing the sum, over the sample period, of squared distances between actual and potential output at each point in time, subject to a restriction on the variation of potential output. The restriction parameter λ captures the importance of cyclical shocks to output relative to trend output shocks, and thereby controls the smoothness of the series of potential output: a smaller value of λ indicates a smaller importance of cyclical shocks and yields a more volatile series of potential output.

Although the statistical methods are attractive because of their simplicity, their shortcomings are well documented. Results given by these methods are not necessarily supported by economic interpretation because they are not model based. Nor are they able to capture structural changes. Furthermore, there are additional shortcomings specific to the HP filter:³ (i) it is difficult to identify the appropriate value of the detrending parameter λ ; and (ii) this technique is susceptible to what is often referred to as “end-point bias” caused by the asymmetry inherent in the filter at the extreme points of a time series, although this problem can be partially corrected by extending the data sample with projections before running the filter.

Output gaps estimated by the HP filter imply an economic overheating in 2007. In order to avoid the end-point bias, the sample period was extended to 2010 using the real GDP projections in the IMF’s Spring 2008 *World Economic Outlook (WEO)*. I estimated potential output and the output gap by applying the HP filter to the quarterly real GDP series for 1996–

³ See Harvey and Jaeger (1993) for details.

2010.⁴ The restriction parameter λ is set at 1,600, as suggested by the literature for quarterly time series.⁵ The results from this method show a large positive swing in output gap during 2006–07 when GDP growth accelerated strongly: the negative output gap in 2005 narrows considerably in 2006 and turns significantly positive in 2007 (Figure 1). Statistical detrending captures a strong growth acceleration as an overheating regardless of its cause—supply driven or demand driven.

B. Production function approach

The second conventional method used—the production function approach— models potential output as a function of potential labor and capital inputs, as well as of potential total factor productivity (TFP). As discussed by Choueiri (2005), potential output is assumed to evolve according to the following equation:

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$$Y^* = A^* \times L^{*\alpha} \times K^{*(1-\alpha)},$$
 (1)

where Y^* is potential output, L^* and K^* refer to potential (or full-employment) labor and capital inputs, A^* is potential TFP, and α is the labor elasticity of output ($(dY/Y)/(dL/L)$). Given the Cobb-Douglas form of the production function, α also equals the labor share in total output, assuming wages reflect the marginal product of labor.⁶ Estimating potential output thus requires identifying full-employment capital and labor input levels, potential TFP, and the labor share.

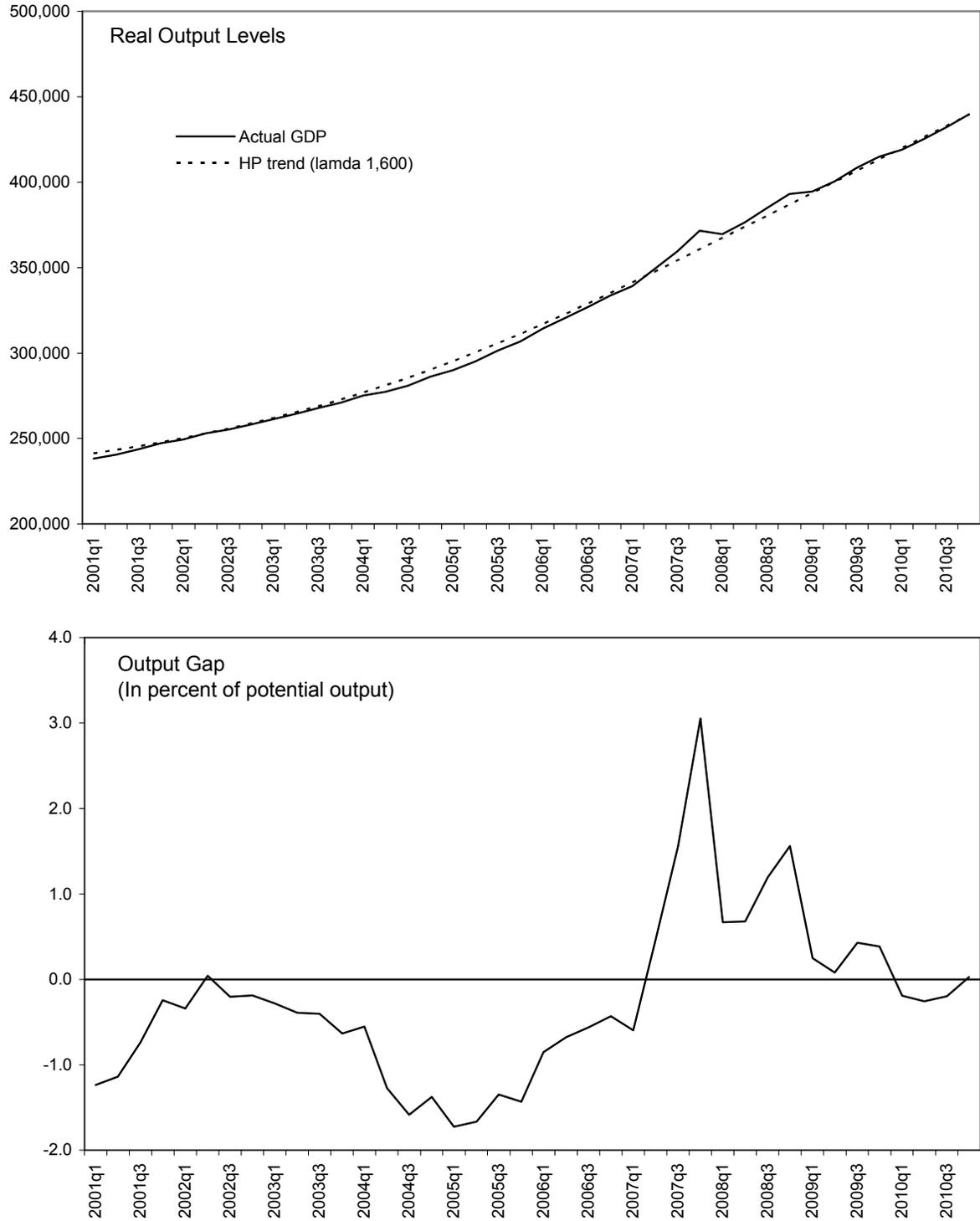
Although the production function approach is based on economic theory, it does not solve the problem of obtaining the trend components of factor inputs. It directly uses microeconomic links between potential output and its inputs. Compared with statistical methods, it can provide useful information on the determinants of growth of potential output. However, potential output and output gap estimates depend crucially on the detrending techniques used for smoothing components of factor inputs. As Cerra and Saxena (2000) point out, problems in obtaining the trend estimates of GDP are simply shifted to the trend estimates of factor inputs.

⁴ The temporary impact on real GDP caused by tobacco excise hikes is excluded from the series of real GDP in this paper.

⁵ I also applied the HP filter with a smaller value of λ , 400, which is sometimes used in output gap estimates in emerging market economies. The results are similar to those obtained using the HP filter with λ at 1,600.

⁶ If W is the economy-wide wage level, then assuming $W=dY/dL$ implies that the labor share, WL/Y , is given by $(dY/Y)/(dL/L)=\alpha$.

Figure 1. Output Gap Estimates Based on HP Filter



Source: Staff estimates.

I use the trend underlying the series of actual employment as potential labor input. Full-employment labor input is estimated by applying the HP filter with λ at 1,600 to the quarterly data of total European System of Accounts (ESA)-based employment for the period 1996–2010.⁷ Actual employment level fell short of the estimated potential in 2004 when employment growth turned negative, but it began exceeding the estimated potential in 2006 when employment growth picked up (Table 1).

Table 1. Full-Employment Labor Input
(ESA basis, in thousand persons)

	2003	2004	2005	2006	2007	2008	2009	2010
Actual employment	2,060	2,056	2,084	2,132	2,174	2,204	2,233	2,255
Potential employment	2,051	2,069	2,096	2,129	2,164	2,199	2,233	2,265
Actual employment in excess of potential employment (in percent)	0.5	-0.7	-0.6	0.1	0.5	0.2	0.0	-0.4

Source: Statistical Office of the Slovak Republic; and IMF staff estimates.

The labor share is calculated as the share of labor income in the total value added, based on the national accounts data. The labor share is estimated at 0.52 on average during 1995–2006. As the Ministry of Finance of the Slovak Republic assumes in its potential output estimates generated by a production function approach, the labor share was fixed at this average value of 0.52 throughout the estimation period of 1996–2010.

Following the literature, I assumed that full-employment capital equals the actual total capital stock. Total capital stock was estimated in two steps. First, a perpetual inventory method was applied to estimate the initial level of the real capital stock at end-1995 by dividing real gross fixed capital formation in 1995 by $(g+\delta)$, where g is the average growth rate of real gross fixed capital formation during 1996–2004 while δ is an annual depreciation rate, which is assumed at 4 percent. The ratio of real capital stock to real GDP in 1995 calculated in this way is 2.8, which is similar to the ratio estimated in the empirical literature on the central and eastern European countries.⁸ Second, to get the real value of capital stock after 1996, the following standard formula was applied:

$$K_{t+1} = K_t + I_{t+1} - D_{t+1} \quad (2)$$

where K is the real value of total capital stock, I is real gross fixed capital formation, and D is real depreciation of capital. An annual depreciation rate of 4 percent was assumed, while real

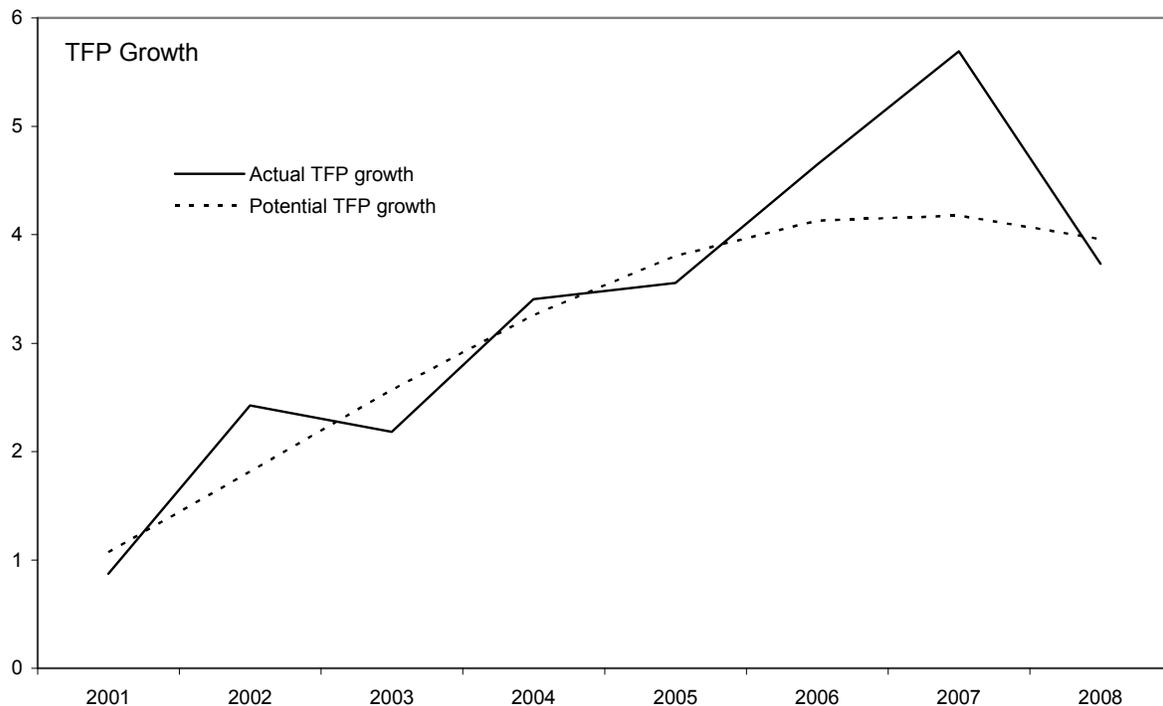
⁷ Actual data are used for the period up to 2007:Q4 while the projections in the IMF's Spring 2008 *WEO* are used for the period after 2008:Q1.

⁸ Estimates on the ratio of real capital stock to real GDP in 1995 given by the Statistical Office of the Slovak Republic seems to be too high: they are more than twice the ratio calculated by the perpetual inventory method.

gross fixed capital formation data for the period 1996–2007 were taken from the national accounts. To project this series for 2008–10, I assumed that the capital stock will continue to depreciate at a 4 percent rate, and that the projected gross fixed capital formation in the Spring 2008 IMF’s *WEO* will add to the capital stock.

Potential TFP was calculated by using the labor and capital input data. First, I calculated the series of actual A , the Solow residual (TFP), by using in equation (1) the actual employment and real capital stock estimated above as inputs, the actual quarterly real GDP as output, and 0.52—the labor share estimated above—as α . Second, I calculated the series of potential TFP by applying the HP filter with λ at 1,600 to the series of actual TFP. Actual TFP growth exceeds the estimated potential TFP growth by a wide margin during 2006–07 (Figure 2). This substantial acceleration of the actual TFP growth during 2006–07 is likely to have been driven by a supply-side impetus: the start of production of new automobile and electronics factories financed by large FDI projects.

Figure 2. Total Factor Productivity (TFP) Growth
(In percent)



Source: Staff estimates.

Output gaps estimated by the production function approach indicate an economic overheating in 2007, similarly to those estimated by the statistical method. The full-employment labor (L^*) and capital (K^*) inputs and potential TFP (A^*) estimated above in equation (1) provide a time series of estimated potential output and the output gap for the

period 1996–2010. The results are similar to those obtained by the HP filter: a large positive swing in output gap during 2006–07—the negative output gap in 2005 narrowed considerably in 2006 and turned significantly positive in 2007 (Figure 3 and Table 2). Output gaps estimated by the European Commission, based on a production function approach, also imply a significant overheating in 2007. The estimates by the Slovak Ministry of Finance, which too rely on a production function approach, show a similar trend, but the size of the positive output gap in 2007 is much smaller than that estimated by the European Commission or by the production function approach in this paper. The Ministry of Finance’s estimates differ because it makes expert adjustments to the potential TFP series, taking into account the impact of large FDI inflows in recent years (Ministry of Finance of the Slovak Republic, 2007).

Table 2. Output Gap Estimates by Conventional Methods
(Percent of potential output)

	2003	2004	2005	2006	2007	2008	2009	2010
Hodrick-Prescott Filter	-0.4	-1.2	-1.5	-0.6	1.1	1.0	0.3	-0.2
Production Function	-0.4	-0.8	-1.0	-0.1	1.6	1.3	0.2	-0.8
Production function with adjustments for the impacts of new factories	-0.5	-0.9	-0.3	0.8	1.6	0.4	-0.2	-0.4
Memorandum items:								
Output gap estimates by European Commission 1/	-3.2	-3.4	-3.2	-1.6	1.9	2.7	2.5	...
Output gap estimates by Ministry of Finance 2/	-0.6	-0.5	-0.9	0.0	0.6	0.5	0.3	0.1

Sources: European Commission; Ministry of Finance; and IMF staff estimates.

1/ Estimates as of April 2008.

2/ Estimates as of January 2008.

It is widely argued among economists that the coming on stream of the new factories during 2006–08, financed by large FDI projects, has distorted the picture by pushing up the growth of potential TFP and full-employment labor input. These noncyclical shocks could bias upward the output gaps estimated by the production function approach during this period. Table 3 summarizes the estimates made by the National Bank of Slovakia (NBS) and by the Ministry of Finance of the direct impact of the new factories of KIA, PSA Peugeot Citroen, and Samsung electronics on total output, capital stock and employment.⁹

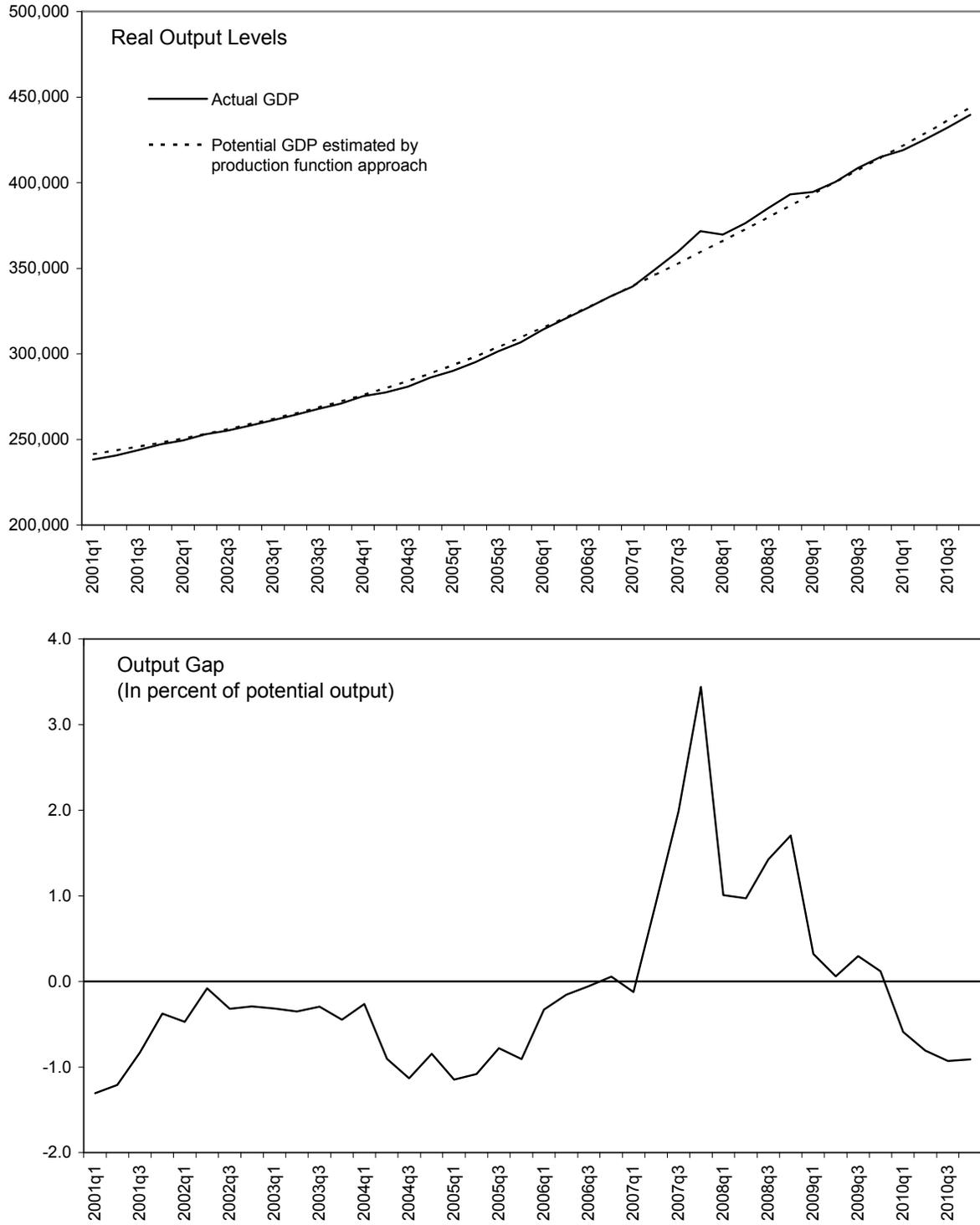
Table 3. Impact of New Factories on Real Output in 2006-08

	2006	2007	2008
Real output (in percent of total output)	0.3	2.0	3.9
Employment (in percent of total employment)	0.3	0.4	0.5
Capital stock (in percent of total capita stock)	1.2	1.4	1.4

Source: National Bank of Slovakia; Ministry of Finance; and IMF staff calculations.

⁹ The impacts on the capital stock are calculated by the IMF staff based on the amount of investments in these new factories given by the Ministry of Finance.

Figure 3. Output Gap Estimates Based on Production Function



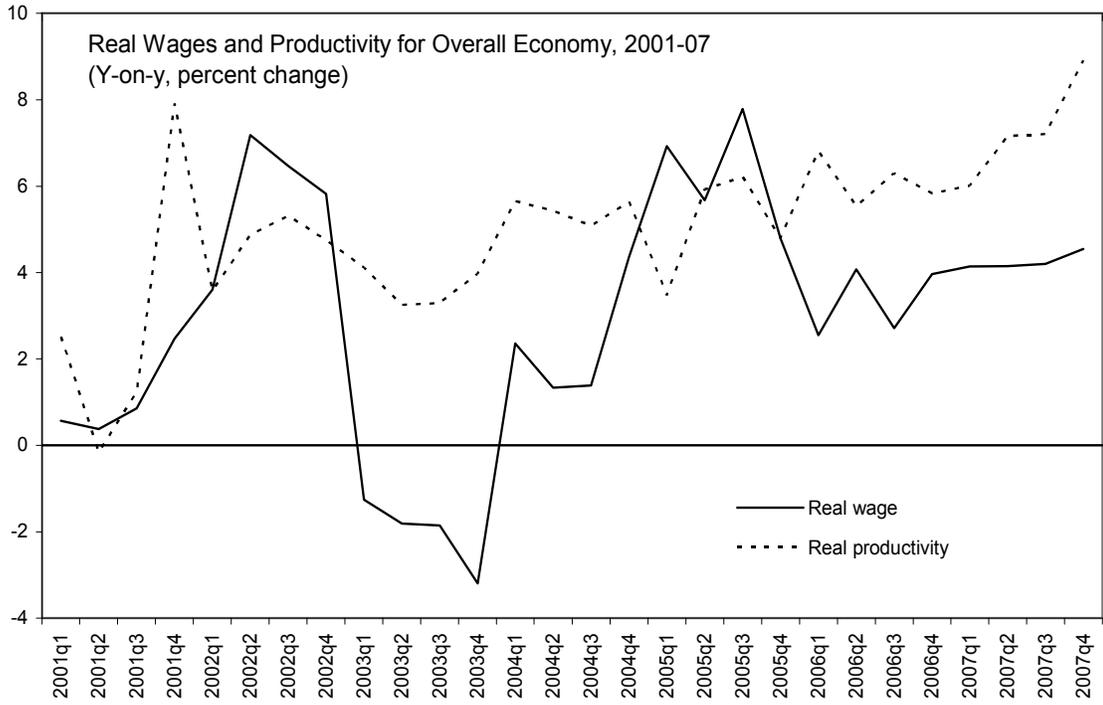
Source: Staff estimates.

Although it would be desirable to remove these noncyclical shocks in estimating potential output using the production function approach, it is difficult in practice to do so. I made two adjustments to calculate potential output and the output gap. First, I calculated the potential TFP, full-employment capital and labor inputs using the series of real GDP, capital stock, and employment excluding the impact of these new factories.¹⁰ This gives the estimates of potential output excluding these new factories. Second, I calculated the potential output of the overall economy by adding the actual output of these new factories to the estimated potential output excluding them. Despite these adjustments, output gap estimates do not change significantly from the one obtained using the production function approach without adjustments (see Table 2). The indirect impact on output, such as an increased integration of downstream supply chains, should have been sizable. However, it is hard to properly measure such indirect impact.

The results given by the statistical and production function approaches discussed above do not match the recent developments of other economic indicators, which show few signs of overheating. Despite a significant decline in the unemployment rate during 2006–07, the labor market has shown little evidence of wage pressures: labor productivity growth exceeded wage growth by a wide margin in 2006, and this margin even widened in 2007 (Figure 4). If the negative output gap in 2005 narrowed considerably in 2006 and turned significantly positive in 2007, as indicated by these results, wage pressures should have been observed by 2007. In addition, the external current account balance improved significantly during 2006–07 (Figure 5). If the economy is overheating, saving- investment balance would be expected to have deteriorated. Furthermore, the strong acceleration of economic growth during 2006–07 is totally attributable to an increase in the contribution of net foreign demand: the contribution of domestic demand even moderated during this period (Table 4). Therefore, a number of recent economic indicators point to an acceleration of growth of potential output, rather than an economic overheating.

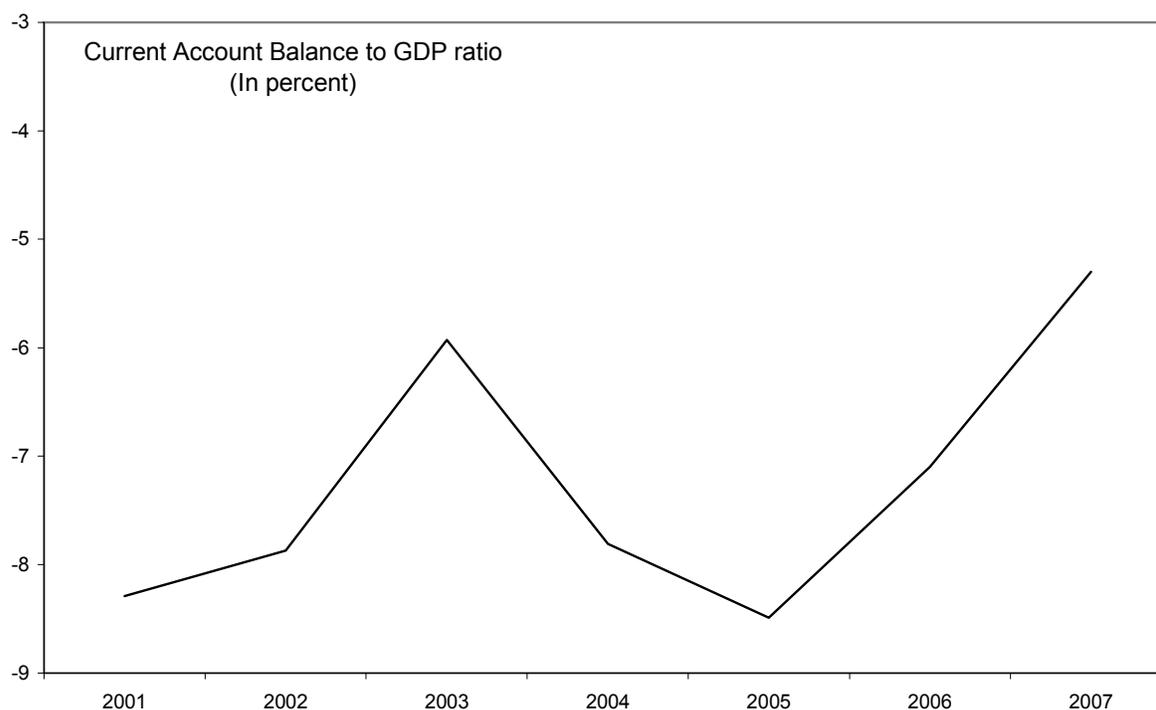
¹⁰ Because only annual data are available for the estimated impacts of the new factories, I estimated the annual series of potential employment and TFP using the HP filter with λ at 6.25. According to the simulations by Ravn and Uhlig (2002), the λ value of 6.25 is appropriate for annual data, given the commonly used λ value of 1,600 for quarterly data.

Figure 4. Labor Market Developments



Source: Statistical Office of the Slovak Republic.

Figure 5. Current Account Balance



Source: National Bank of Slovakia; and Staff estimates.

Table 4. Contributions to Growth, 2003–07
(Percentage points)

	2003	2004	2005	2006	2007
Real GDP growth	4.8	5.2	6.6	8.5	10.4 1/
Domestic demand	-1.0	6.0	8.7	6.2	4.9
Of which:					
Private consumption	0.9	2.4	3.6	3.2	3.8
Fixed investment	-0.7	1.2	4.4	2.3	2.2
Change in stocks and statistical discrepancies	-2.1	2.7	0.0	-1.1	-1.2
Net foreign demand	5.7	-0.8	-2.1	2.3	5.4
Memorandum item:					
Current account balance (in percent of GDP)	-5.9	-7.8	-8.5	-7.1	-5.3

Sources: Statistical Office of the Slovak Republic.

1/ A boost to excise collection accompanying the pre-stocking of tobacco products in late 2007, in anticipation of a tobacco excise hike in January 2008, pushed up real GDP growth by about 0.8 percentage point.

Conventional approaches for estimating output gaps cannot capture a structural shift of the potential growth path. They rely on statistical detrending and focus narrowly on output and input developments. They tend to produce output gap estimates that cannot be reconciled with the dynamics of economic imbalance indicators when the economy is growing strongly, underpinned by a supply-side impetus, as is the case in Slovakia.

III. MV KALMAN FILTER APPROACH

The MV Kalman filter approach is applied in this section in an attempt to overcome the shortcomings of the conventional methods. This method treats a filtering problem as a small system in which the estimates of potential output and some of the parameters of a dynamic model are determined simultaneously. Its potential disadvantage is that parameter estimates may be very imprecise and the results may be sensitive to the choice of starting values.¹¹ However, this approach has an advantage over the conventional methods. As Benes and N'Diaye (2004) and Gagales (2006) point out, it allows us to incorporate economic theory to sharpen the identification of the cyclical and trend components of output dynamics. In particular, it may be useful to exploit information about the degree of excess demand in the labor market because it is likely that there has been excess demand in the product market when we observe wage pressures picking up in the labor market. In sum, this method allows us to take into account interactions between output and labor market conditions.

To estimate potential output and the output gap, I applied the MV Kalman filtering method to a small system as follows, using quarterly data for 1996–2010 from the IMF's Spring 2008 *WEO*:¹²

$$y_t = \bar{y}_t + ygap_t \quad (3)$$

$$\bar{y}_t = \bar{y}_{t-1} + \mu_{t-1} + \varepsilon_t^y \quad (4)$$

$$\mu_t = \beta\mu_{t-1} + (1 - \beta)\bar{\mu} + \gamma * YearDummy + \varepsilon_t^\mu \quad (5)$$

$$ygap_t = \alpha_0 ygap_{t-1} + \alpha_1 ygap_{t-1}^f + \varepsilon_t^{ygap} \quad (6)$$

$$\Delta^2 ULC_t = \theta_0 + \theta_1 ygap_t + \varepsilon_t^w, \quad (7)$$

The system of equations works as follows:

- In equation (3), y_t is the log of observed seasonally adjusted quarterly real GDP, \bar{y}_t is potential output, and $ygap$ is the output gap. This is an identity; it simply defines what we mean by $ygap$.

¹¹ See, for example, Gagales (2006), Laubach and Williams (2003).

¹² The program that implements the MV Kalman filter has been written in Eviews 5.

- Equation (4) says that potential output follows a random walk with a time-varying drift. Variable μ_t is the quarter-on-quarter growth rate of potential output.
- Equation (5) specifies that potential output growth evolves according to a first-order, stationary, autoregressive process, reverting in the long run to a fixed steady-state rate of quarter-on-quarter growth, $\bar{\mu}$. The value of the parameter β should be larger than zero but smaller than one. The larger the value of β , the more persistent the impact of shocks on the potential growth rate. I added a year dummy for 2006 and 2007, as potential growth is most likely to have picked up during these two years because production started in the new factories financed by the large FDI projects.
- Equation (6) specifies that the output gap is a positive function of its own output gap and of its export markets' output gap both lagged by one period, reflecting Slovakia's nature of small-open economy. To obtain the export markets' output gap series, I applied the HP filter with λ at 1,600 to the quarterly time series of real GDP in each of the ten largest export markets of Slovakia and took a weighted average of the estimated output gap of each country, using its share in Slovak exports to these ten countries as a weight.¹³
- In equation (7), $\Delta^2 ULC_t$ is the change in the growth rate of nominal unit labor costs. This equation is the Phillips curve relationship with static inflation expectations, as proposed by Elmeskov (1993). It states that the growth rate of unit labor costs accelerates when the output gap swings in a positive direction.¹⁴
- All error terms in equations (4)–(7) are assumed to be identically, independently normally distributed and to be uncorrelated.

Output gap estimates obtained by the MV Kalman filter method fit the dynamics of economic imbalance indicators in recent years. The system of equations (3)–(7) was processed using an application of Kalman filtering. The estimated values of parameters are given in Table 5. Although parameter estimates are generally imprecise, all coefficients have the expected sign. Note that θ_1 is significantly different from zero. This means that there is a statistically significant link between the output gap and the growth rate of unit labor costs, which cannot be exploited effectively by the conventional methods. Figure 6 reports the

¹³ The ten largest export markets comprise Austria, the Czech Republic, France, Germany, Hungary, Italy, the Netherlands, Poland, the United Kingdom, and the United States.

¹⁴ There may be some lags for unit labor cost's growth to accelerate in response to a positive swing in the output gap. To check robustness, I also estimate the output gap by allowing lags (up to four quarters) for $ygap$ in equation (7). The results are very similar to those reported in Figure 6 and Table 6.

potential output and output gap estimates obtained by this method. Although the trend of the output gap in recent years is similar to that estimated by the conventional approaches, its magnitude is very different (Table 6). The negative output gap observed in 2005 barely narrows in 2006, while the output gap is almost zero in 2007. Few signs of wage pressures and a substantial improvement in the external current account balance point to a negative or near-zero output gap during 2006–07, rather than the large swing into positive territory indicated by the conventional methods. The MV Kalman filter estimates are much more plausible than those from the conventional methods when the economy is experiencing rapid growth, driven by a supply-driven impetus: it can incorporate the economic links between the output gap and other economic indicators, such as wage pressures in the labor market.

Table 5. Values of Parameters 1/

α_0	α_1	β	$\bar{\mu}$	γ	θ_0	θ_1
0.6865 (0.8664)	0.1512 (0.7274)	0.7377 * (0.4366)	0.0108 (0.7683)	0.0036 (0.1473)	0.0074 (0.2962)	0.0067 * (0.0039)

Sources: IMF staff estimates

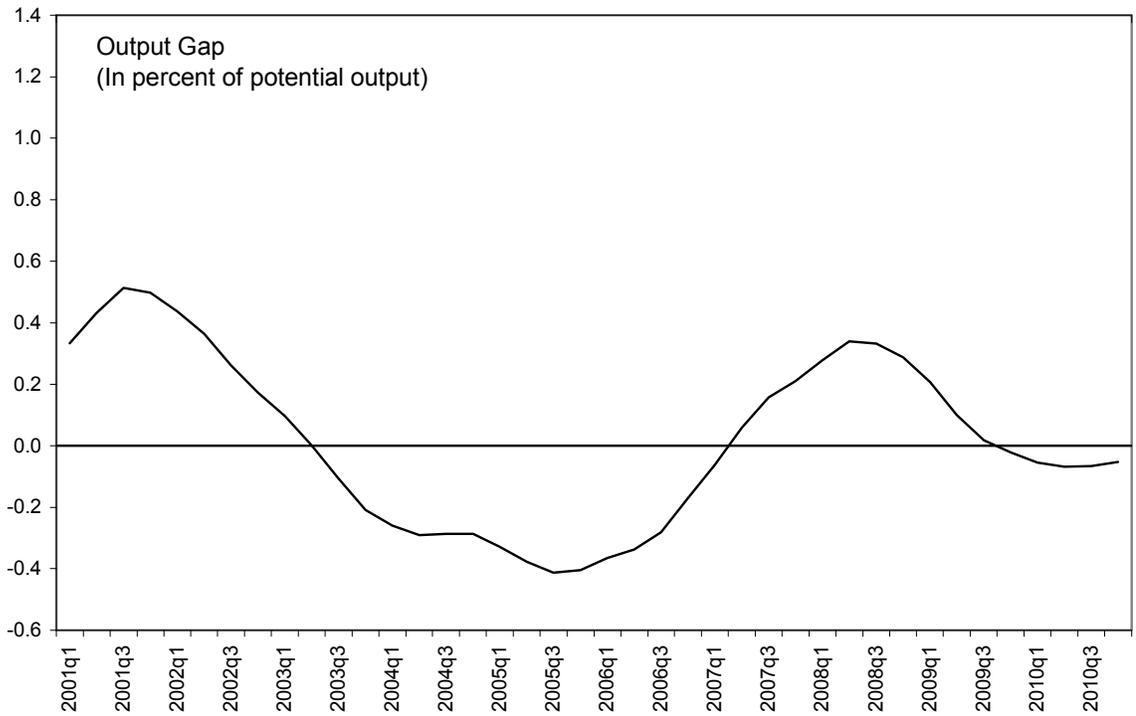
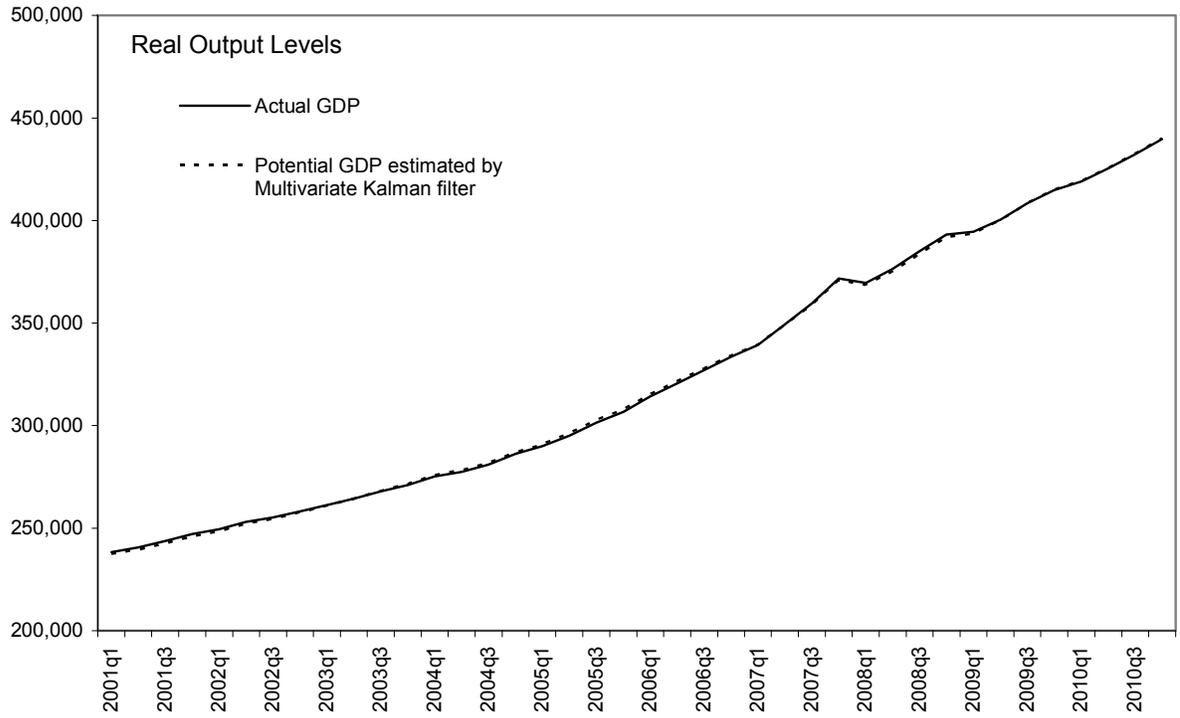
1/ Standard errors are in parenthesis; * indicates statistical significance at the 10 percent level.

Table 6. Output Gap Estimates by MV Kalman Filter Approach
(Percent of potential output)

	2003	2004	2005	2006	2007	2008	2009	2010
Multivariate Kalman filter	-0.1	-0.3	-0.4	-0.3	0.1	0.3	0.1	-0.1

Sources: IMF staff estimates

Figure 6. Output Gap Estimates Based on Multivariate Kalman Filter



Source: Staff estimates.

Output gaps estimated by the MV Kalman filter method also go well with the historical dynamics of slack in the labor market. Figure 7 plots real productivity growth minus real wage growth, a difference which proxies slack in the labor market, on the y-axis, against the output gaps estimated by the HP filter, the production function, and the MV Kalman filter, on the x-axis. As there may be lags for the labor market slack to respond to the output gap, Figure 8 plots real productivity growth minus real wage growth on the y-axis against the one-year lagged output gap estimates on the x-axis. A downward-sloping relationship should be observed in these figures because an increase in the output gap should lead to a decline in the slack in the labor market. In both Figures 7 and 8, only the output gap estimates given by the MV Kalman filter method provide the expected pattern in the best fitted line. Conventional methods, meanwhile, provide output gap estimates that are positively related to a slack in the labor market.

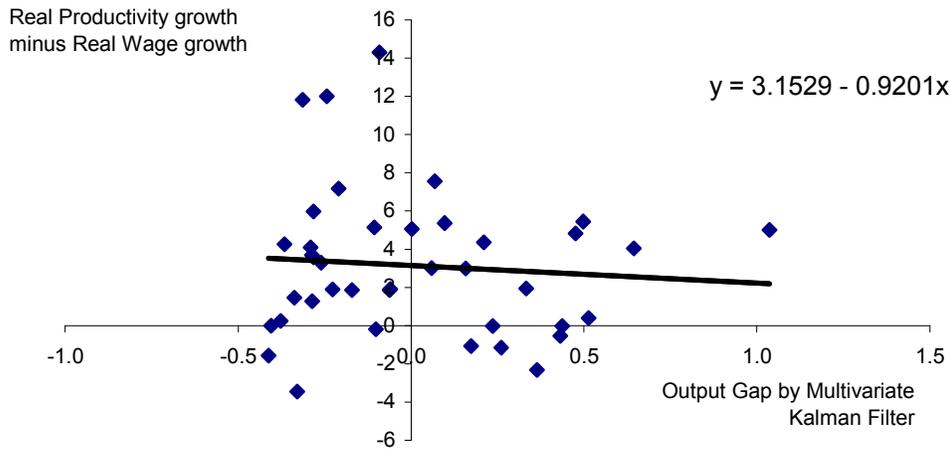
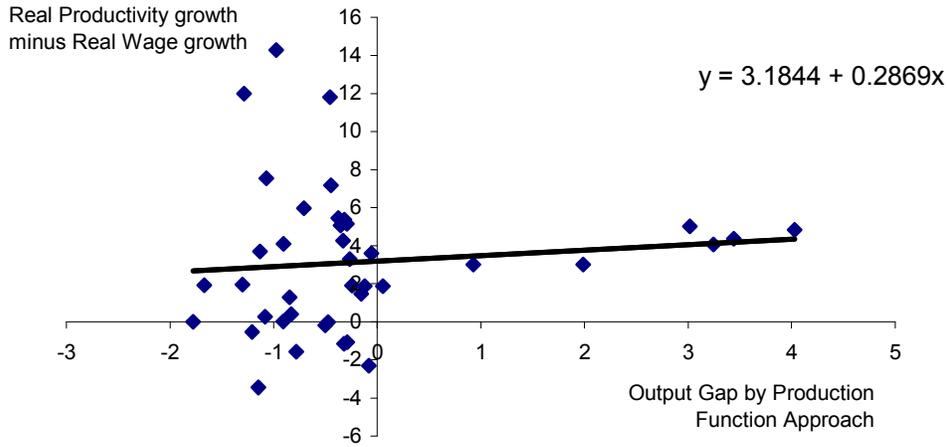
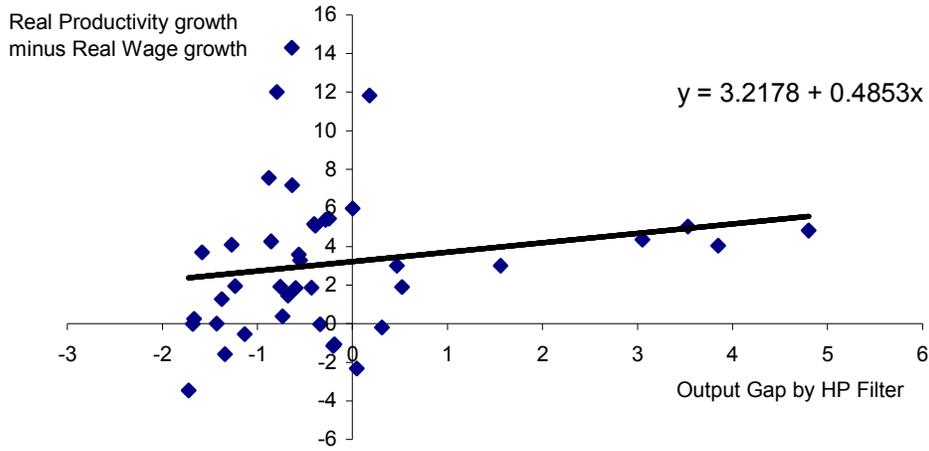
Moreover, the output gaps projected by the MV Kalman filter method also fit with the pattern of projected economic imbalance indicators. The MV Kalman filter method provides almost-zero or small positive output gap estimates for 2008–10. This matches the developments in the current account balance and the productivity-wage relationship projected by the IMF staff during this forecast period better than the output gaps estimated by the conventional methods. The macroeconomic framework in the IMF’s Spring 2008 *WEO* projects that the current account balance will improve steadily and that productivity growth will continue to exceed wage growth (Table 7). Many institutions, including the Slovak authorities (Ministry of Finance of the Slovak Republic, 2007) and the European Commission (2008), are forecasting a similar pattern for the saving-investment balance and wage-productivity relationship. On the other hand, the output gaps indicated by the conventional methods—significantly positive in 2008—cannot be reconciled well with the projected macroeconomic framework. As the MV Kalman filter method provides the most plausible output gap estimates, the next section will discuss the policy implications of the output gap estimates given by this method.

Table 7. Economic Imbalance Indicators, 2007–10
(Percentage points)

	2007	2008	2009	2010
		IMF Staff Projections		
Real wage growth	4.3	3.7	3.9	3.9
Real labor productivity growth	7.3	5.7	4.9	5.0
Real labor productivity growth minus real wage growth	3.1	2.1	1.0	1.1
Current account balance (in percent of GDP)	-5.3	-5.0	-4.7	-4.5
<i>Memorandum item:</i>				
Output gap estimates (in percent of potential GDP)				
by HP filter	1.1	1.0	0.3	-0.2
by production function	1.6	1.3	0.2	-0.8
by Multivariate Kalman filter	0.1	0.3	0.1	-0.1

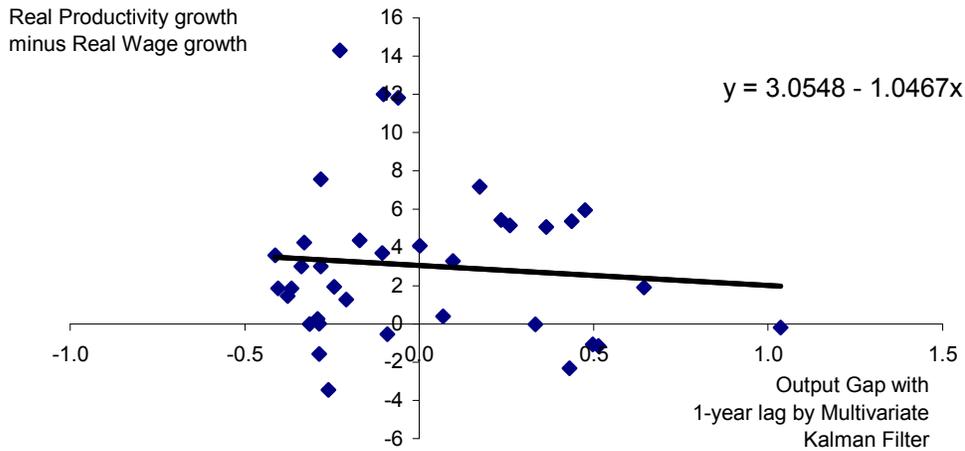
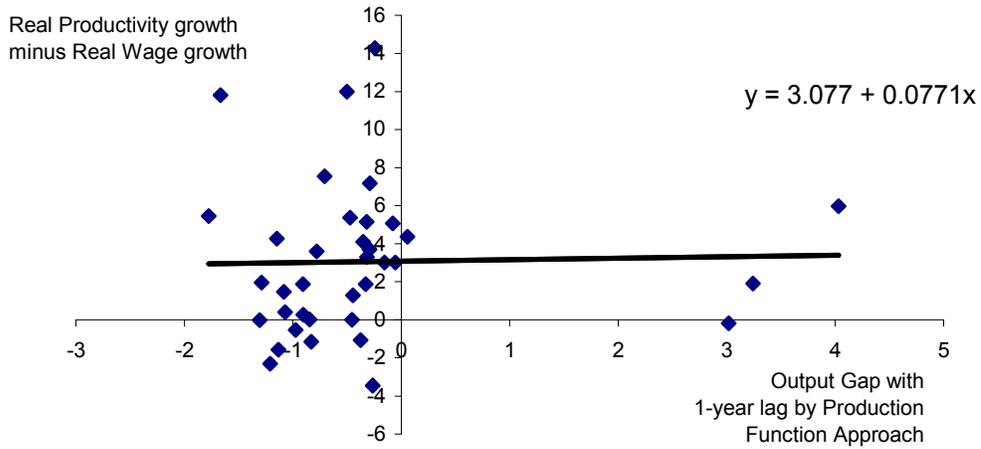
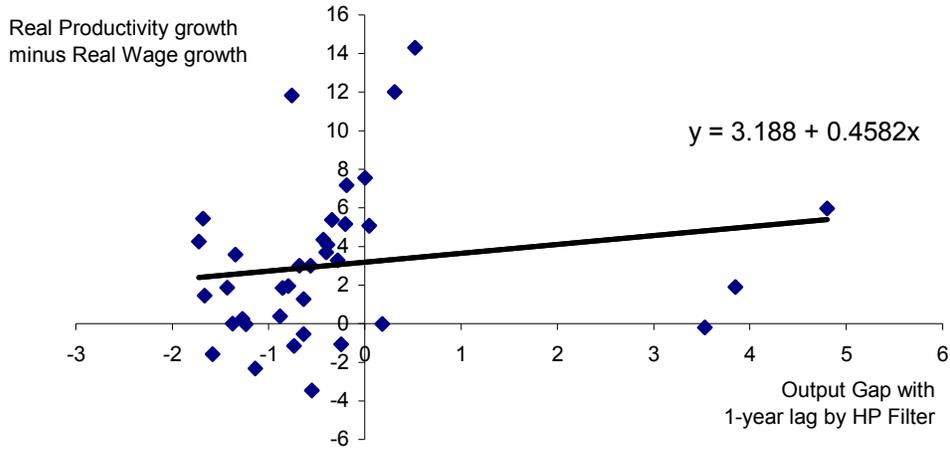
Sources: Statistical Office of the Slovak Republic; and IMF staff estimates.

Figure 7. Productivity Wage Gap and Output Gap Estimates



Source: Staff estimates.

Figure 8. Productivity Wage Gap and Output Gap Estimates with 1-year Lag



Source: Staff estimates.

IV. POLICY IMPLICATIONS OF OUTPUT GAP ESTIMATES GIVEN BY THE MV KALMAN FILTER

The output gaps estimated by the MV Kalman filter method indicates that Slovakia could continue its strong economic performance in the monetary union if it sticks to its prudent policies. Slovakia will adopt the euro in January 2009. A pick-up in demand-pull inflation is often observed around the time of adopting a single currency by a small-open economy. Headline inflation has accelerated since late 2007, indeed. However, this is largely due to global supply-side factors, such as higher international food and energy prices, rather than demand-side pressures. More importantly, the output gap is estimated around zero in recent years despite the rapid growth. This suggests that Slovakia could enjoy relatively high growth without accelerating inflation in the monetary union if fiscal policy remains cautious and if the country continues with structural reforms to further improve labor market flexibility and the business environment.

V. CONCLUSIONS

This paper has proposed a method for obtaining measures of excess demand that are more sensible in economic terms than the conventional approaches. The MV Kalman filter method presented here uses a small system that takes into consideration the interactions between output gap estimates and wage pressures in the labor markets. It produces estimates of excess demand that characterize much more realistically the situation in recent years in Slovakia and provides a better base for conducting macroeconomic policy than the conventional methods.

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