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### **MIND THE GAP – WATCH THE WAYS OF CYCLICAL ADJUSTMENT OF THE BUDGET BALANCE<sup>+</sup>**

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## **Abstract**

Cyclically adjusted budget deficit (CAB) is a widely cited and used concept in the evaluation of fiscal situation. The key idea behind it is to separate temporary and/or non-discretionary effects on budget deficit from the underlying balance and/or effects of discretionary measures of fiscal policy. The computation of CAB is based on the identification of potential level of economic variables. In this paper we demonstrate, that composition matters both in the case of real and nominal variables. Both European Commission and European Central Bank propose methods for measuring CAB, however, they are not fully capable of satisfying all requirements. Besides, results show that aggregated and disaggregated approaches provide different estimations for the benefit of the latter. In this paper we present an alternative method, which is able to incorporate the advantages of both approaches. Combining output gap from production function and constrained multivariate HP filter induces theoretically motivated disaggregated approach where we also exploit the implication of production function parameterisation. Taking into account nominal features, for example nominal elements of the tax code or deflators directly affected by the government, the more precise definition of discretionary measures became also important.

JEL Classification Number: H62, E32

Keywords: cyclically adjusted budget deficit, price gap, business cycles, constrained multivariate HP filter

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## I. Introduction

Methods of the cyclically adjusted balance (CAB) seek to capture the significant effects of the business cycle on budget revenues and expenditures. Temporary improvements in fiscal positions due to a speed up in economic activity are self-reversing as activity slows down and should therefore not be seen as an underlying improvement in the fiscal situation. CABs may also provide some indication of the degree of discretionary fiscal policy, i.e. a part of the fiscal impulse that the government implements over the automatic stabilisers. However the demand impact of automatic stabilisers is not necessarily different from that of the discretionary actions.

CABs are employed in a number of ways. Some analysts use CABs for analysing fiscal sustainability, removing temporary effects on the budget. They also assume that there are no exogenous effects other than cyclical ones, and that there are no temporary discretionary measures.

However some studies (e.g. Blanchard 1990) emphasise that CABs were not designed to answer all the questions. Changes in CABs (or in its primary version) are sometimes used as simple measures of impact of the fiscal policy (European Commission 2000, Van den Noord 2002). Other studies (Chalk, 2002) argue that CABs are inherently unable to approximate even the indication of the presence of the fiscal impulse, let alone its size. At the same time, however, they are more suitable for measuring the degree of fiscal activity, provided that effects such as exchange rates, inflation and interest rates have no significant impacts on the deficit. Since these assumptions are not very realistic, an OECD working paper (Buti and van den Noord 2002) recommends additional correction with the so-called inflation gap to capture the discretionary component of the budget.

These theoretical approaches can be compared to the results of empirical studies (Chalk, 2002, Krogstrup, 2002). Their results suggest that traditional fiscal indicators such as structural deficits of the IMF, OECD and EU are unable to capture both the demand impact and the degree of discretionary policies.<sup>1</sup>

The most obvious reason for these failures is related to the above mentioned difficulties with the underlying assumptions (e.g. no other exogenous effects and temporary measures). Sometimes these problems are addressed by employing cyclically adjusted primary balance (CAPB) instead of CAB. In this paper we focus on the primary balance, but we also address this problem by employing a simple price gap.

Another likely reason is that unadjusted deficit, *ab ovo*, contains only partial information; for example, certain off-budget activities are excluded, therefore, the 'true' situation remains hidden. We plan to address this question in another paper<sup>2</sup>. A further explanation for the shortcomings of CABs lies in the specific methods of cyclical adjustments. Our paper concentrates on the methodological issues of cyclical adjustment, seeking to find a proper alternative approach for Hungary.

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<sup>1</sup> Krogstrup runs a panel regression of changes in demand on the change of fiscal indicators, namely the total deficit, the structural deficits (CABs) of the IMF, OECD and EU and the "Fiscal Impulse" indicator. Chalk examined the demand stimulus, structural component and discretionary of the deficit both in theory and practice. This study focuses on the structural deficit (CAB) of the OECD and an indicator of the demand impact weighted by multipliers.

<sup>2</sup> In Hungarian see P. Kiss (2002).

The following sections examine the cyclical position of the economy and budgetary sensitivity to the cycle; finally multiplying these two factors, we calculate the cyclical component of the budget. In each section, we present an application of the European Commission (EC) approach, then a calculation under the European Central Bank (ECB) method and, finally, a proposed new approach called the production function –constrained multivariate HP filter (PF-CMHP) method.

The EC employs its own method in measuring the cyclical position of economy. Nevertheless, it determines budgetary elasticities, accepting the systematic calculations by the OECD. Therefore, in Section 3, we treat EC and OECD approaches as basically the same. We failed to reproduce this OECD method, but we applied their concepts as closely as possible. The ECB approach measure the cyclical effects with a disaggregated way, also distinguishing the direct effects of public spending on real variables (wages, consumption) from the effects of private decisions. Contrary to the standardised method of budgetary elasticities, the ECB approach, which is the common method of the European System of Central Banks (ESCB), grants more flexibility in taking into account of the special features of each country.

In Hungary the disaggregated approach has been identified as the more relevant way of the cyclical adjustment, because the aggregate output gap and its composition have been rather different in the past few years. The significantly different budgetary implications of these kinds of ‘atypical’ circumstances were taken into account in some ad hoc analyses (European Commission, 2000), and a few new methods were introduced (European Central Bank, 2001, P.Kiss, 2002). Applying these disaggregated approaches, we find a positive fiscal cyclical component in recent years in Hungary in spite of the negative output gaps.

This paper is structured as follows. Section II discusses the cyclical position of real economy. After outlining the production function approach of the European Commission and the HP-filtered disaggregated method of the European Central Bank, we develop our approach, which can cope with the problems of the EC and ECB methods. Concluding this section, we introduce a price gap, which is crucial to measuring the full effects on the cyclical position of the budget deficit. In Section III, we estimate the cyclical elasticities of budget incomes and expenditures to real economic variables. Similarly to Section II, we go through EC, ECB and our approaches. Section IV presents the results showing the cyclical components of Hungarian budget deficit. Finally, Section V comprises our conclusions.

## II. Measuring the cyclical position of the economy

The cyclical position of the economy is a commonly cited and widely used concept in the evaluation of current states of affairs by both policy makers and analysts. Although the intuitive concept of the cyclical position is quite common among economists, the way it is measured provides ground for discussions. This disagreement is induced by the nature of the cyclical component, i.e. that it is unobservable, and thus cannot be measured statistically.

There are several econometric ways to handle this problem, and practically all of them have been tested as possible candidates for measuring trends and cyclical positions. Due to the large number of approaches, we focus our examination only on the methods proposed by the European Commission (EC) and the European Central Bank (ECB). Finally, we develop our approach based on the lessons that can be drawn from the EC and ECB methods.

### II. 1. The European Commission approach

The key idea of each approach is to determine the potential level of related variables. The EC approach focuses on the aggregate output gap, and derives its effect on the budget. Denis *at al* (2002) describe the Cobb-Douglas production function using neutral technological progress as the standard way to estimate potential output.

$$Y_t = TFP_t L_t^\alpha K_t^{1-\alpha} \quad (1)$$

where  $Y$ ,  $L$ ,  $K$  and  $TFP$  denote output, labour input, capital stock and total factor productivity respectively. Instead of estimating labour ( $\alpha$ ) and capital ( $1-\alpha$ ) shares the EC suggests using national accounts to calibrate them. Finally,  $TFP$  is defined as the Solow residual.

Next step is to compute NAIRU (the non-accelerating inflation rate of unemployment), which is needed for deriving potential labour force. Since NAIRU is also an unobservable variable, Denis *at al* (2002) recommends the following state space model:

*Signal equations:*

$$U_t = UT_t + UC_t \quad (2)$$

$$\Delta w_t = \mu_t + \gamma X_t + \beta UC_t + u_t, \quad u_t \sum_{i=0}^I \theta_i \varepsilon_{t-i} \quad (3)$$

where  $U$ ,  $UT$ ,  $UC$ ,  $\Delta w$ , and  $X$  denote unemployment rate, trend unemployment (NAIRU or NAWRU), unemployment gap, wage inflation and other exogenous variables.

*State equations:*

$$UC_t = \phi_1 UC_{t-1} + \phi_2 UC_{t-2} + v_t \quad (4)$$

$$UT_t = \eta_t + UT_{t-1} + z_t \quad (5)$$

$$\eta_t = \eta_{t-1} + a_t \quad (6)$$

Unemployment gap should be stationary, thus  $\phi_1 + \phi_2 < 1$  restriction should be fulfilled. The trend unemployment rate is modelled as a random walk with drift, while the drift follows a random walk.

The final steps in deriving potential output are to (1) subtract trend unemployment from labour force to obtain potential employment, (2) apply HP filter to the TFP and substitute them into the production function.

$$YP_t = TFP_t^{HP} [(1 - UT_t)LF_t]^\alpha K_t^{1-\alpha} \quad (7)$$

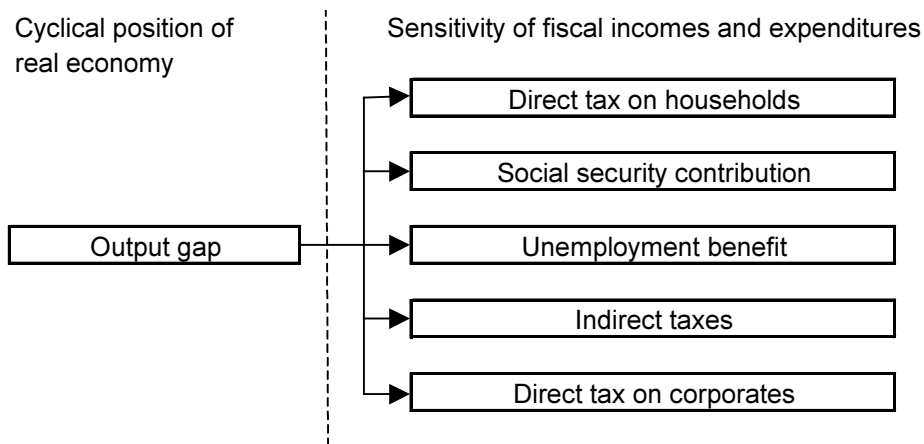
and the output gap is computed in the usual way  $OG_t = Y_t / YP_t$ .

Unfortunately the aforementioned method has several drawbacks in the case of Hungary. Firstly, labour share has been changing since the beginning of transition. Capital share rose from 30% to 40% during the 90's and has declined in recent years. To overcome this phenomenon, we used the 'average' share for these periods, which numerically coincides with the EC suggestion, namely a wage share of 65% and capital share of 35%. Due to this phenomenon, we suggest an alternative approach, which can handle the time-varying wage share without altering the production function form.

Secondly, the unemployment rate showed an extreme pattern in the 90's. In the early years of transition, the rate of unemployment jumped to 12%, and then decreased gradually to 5% by 2002. As a result, the unemployment rate shows a negative-slope linear trend in Hungary. Owing to this phenomenon in macroeconomic time series, we have to use a simple HP filter without any economic meaning of the resultant unemployment gap.

Obtaining a output gap (see Figure 9a) and identifying the cyclical position of the whole economy, the EC approach applies elasticities to compute the cyclical position of the relevant GDP components, such as private wages, consumption and corporate profit etc. These cyclical positions are derived by estimating the co-movement between output and corresponding variables.

Figure 1 Structure of the EC approach



Another problem comes from the definition of the elasticity of the real economic variable. As has been mentioned, the EC approach picks up the elasticities of estimated equations. It seems unambiguous, however, that there are three main problems:

- Firstly, estimating certain elasticities does not take into account and exploit the consequences of choosing the production form, namely that the sum of the labour and capital income gap, weighed by labour and capital shares, should be equal to the aggregated output gap.
- Secondly, the short-time adjustment can be confused with the long-time adjustment to output even in cases where the estimation of elasticities does make sense, for instance in the case of consumption elasticity to wages. Correct estimates allow for a long-time equilibrium with short time dynamics and apply error correction model; however, there is no way to find a parameter in equation, which measures the elasticity. If one considers the long-time parameter then one assumes infinite-speed adjustment. To read it in another way, it should be assumed that there is no effect of the previous gap on the recent position of other variables. Briefly, a long-lasting negative output gap has the same effect on wages and consumption as does a one-year-long negative gap that follows a positive one. Intuitively, we can also rule out that current state variables are independent of previous positions.
- Although estimation on annual data can reduce this effect to some extent, a second problem arises in accession countries. Namely that annual time series are quite short, and the only way to obtain econometrically acceptable results is to use quarterly data. In this case the above-mentioned problem crops up more seriously since the speed of adjustment is slower here than in the case of the annual data.

The long run elasticities of Hungarian economy are displayed in Table 11, Section VII. 3. 2. However, in order to avoid the lack of consistency and the assumption of infinite-speed adjustment or ‘static’ approach, we develop an alternative framework.

## ***II. 2. The European Central Bank approach***

The European Central Bank contests the cyclical position measure of the European Commission. Boije (2004) argues that (as a result of the EC approach) the aggregate output gap hides the underlying process. While the same output gap can be made up from various components, this gap may have different effects on the economy and the budget.

Table 1 displays a fictive example how different underlying economies could provide the same aggregate output gap. While the first economy is hit by a foreign demand shock, i.e. negative export gap, the second economy faces a negative consumption shock. Since export has a smaller direct effect on budget position than consumption does, the cyclical effect on the budget is smaller in the first economy. However, the EC approach calculates exactly the same effect based on an identical aggregated output gap. This phenomenon may explain Cronin and McCoy’s results (1999). They found that the constant elasticities of budgetary revenue and spending on output were not plausible. However, these results may be attributed to the above-mentioned fact. Even if elasticities on disaggregated gaps are stable, elasticity on the aggregate differs if the shares of disaggregated gaps are not constant, which are likely to hold true for all countries.

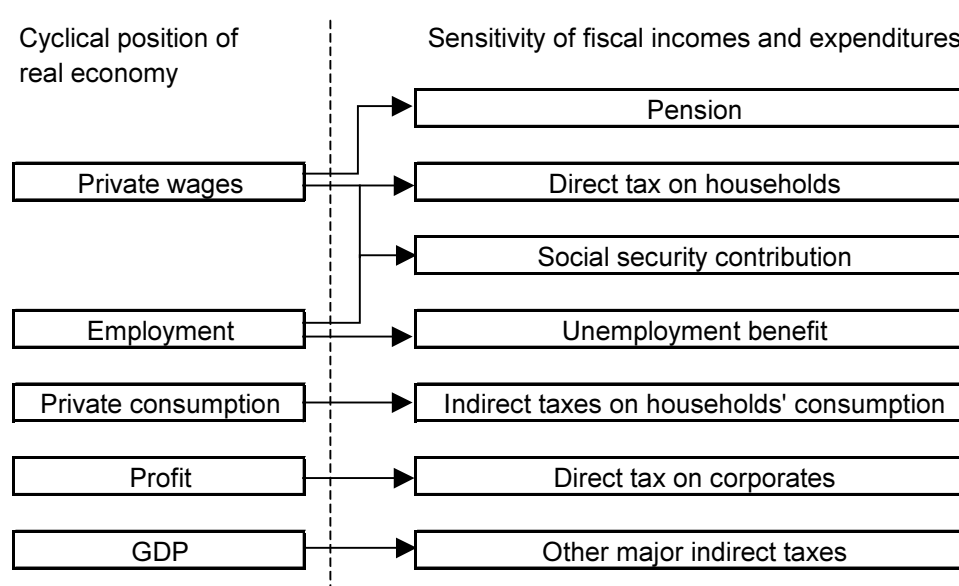
**Table 1 Distortion attributable to the use of the aggregate output gap – an illustration**

	Foreign demand shock	Domestic (private consumption) shock
<b>GDP*</b>	<b>-1.0</b>	<b>-1.0</b>
Export	-3.8	-1.2
Private investment	-2.2	2.0
Private consumption	0.3	-3.2
<b>Effect on budget (% of GDP)**</b>		
Budget deficit	0.2	0.6
Budget expenditure	0.0	0.0
Budget income	-0.2	-0.6
Public debt	1.1	1.4

Source: European Commission estimation on Euro area. \* Percentage difference from the baseline. \*\* Percentage point difference.

Based on the foregoing, the ECB proposes a disaggregated method. Bouthevillain *et al* (2001) estimate numerous gaps, such as private wages, employment, consumption, corporate profit and the unemployment gaps, using Hodrick-Prescott filter.

**Figure 2 Structure of ECB approach**



Although this method helps to identify the various cyclical positions of relevant economic factors, and is extremely easy to adapt, there are some problems weakening its acceptability.

The most trivial one is that using only one univariate method may result in an extreme solution that cannot be revealed, since there is no control method underpinning it. Moreover, Darvas and Vadas (2003) prove that better results can be achieved by using several methods. From the point of view of policy making, the stability of the output gap estimation is crucial. Methods, which provide extensive revision in the estimated output gap, cannot be used in policy decision-making, since they may frequently render previous decisions inadequate. Using a revision-based weighting scheme, Darvas and Vadas (2003)

found that a multiple-method approach provides more stable output gap estimation than the adoption of a single method.

The most important and relevant objection to HP filtering is that there is no theoretical relationship among variables. Bouthevillain *et al* (2001) and Mohr (2003) argue that the linear nature of the HP filter ensures theoretical consistency among variables, as the weighted sum of disaggregated HP-filtered gaps equals to the aggregate gap. Even though the HP filter is linear, this characteristic cannot be exploited in the field of economic time series since economic time series should be log-transformed in the HP filter (Section VII. 1 substantiates this statement), and as a consequence, aggregation constraint is not satisfied. To prove this, we break down the output into labour income and profit, using wage ( $\alpha$ ) and profit shares ( $1-\alpha$ ). Figure 5 and Figure 7 show the HP filtered aggregated output gap and weighted labour income and profit gaps for Hungary and some developed countries.

Contrary to problems of HP filter approach we do agree that aggregate output gap could hide relevant underlying processes. Figure 9(a) and (c) display output and consumption gap estimates, which use the EC's production function approach, the HP filter and the PF-CMHP approach (see below). It is easy to realise that while aggregate output gap shows a negative cyclical effect on the budget balance, the private consumption expenditure contributes to it in a positive manner.

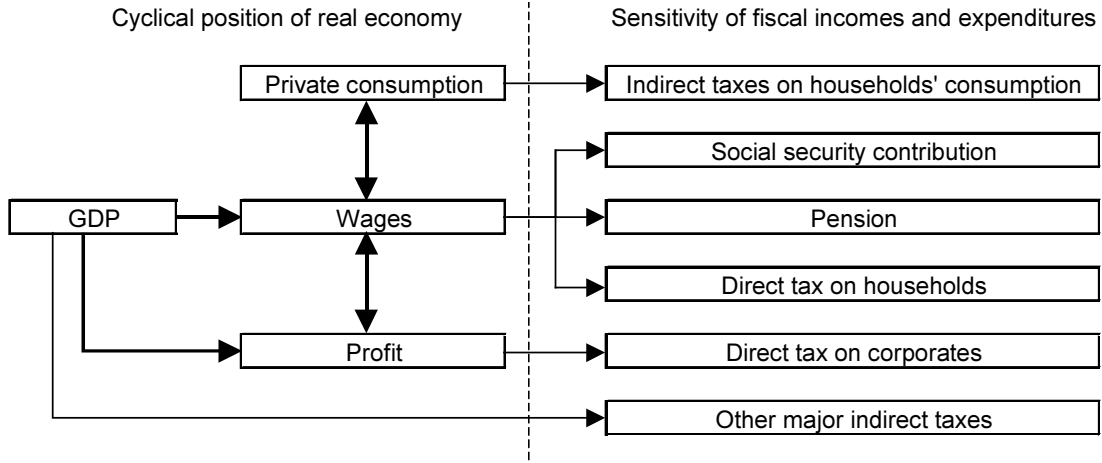
To conclude, we also argue for the importance of the disaggregated approach; however, we insist on the existence of a theoretical relationship among cyclical components and the satisfied aggregation constraint.

### ***II. 3. The production function and the constrained multivariate HP- filter (PF-CMHP)***

In this part we establish an easily tractable method, which can handle the above-mentioned problems. Briefly, we propose the usage of production function since it is based on broader information content and factors, which define the aggregate gap, can be identified. Due to the fact that labour and capital shares were not constant in Hungary we take into account the time-varying labour and capital shares. Moreover, these shares should be applied when the aggregate output gap is decomposed into its components. Another advantage of our method is that aggregation constraint (i.e. aggregate output gap equals the weighted sum of disaggregate gaps) is not only fully satisfied but also it is set by using the labour and capital shares.

Although the above-mentioned criteria could identify the labour compensation and profit income gaps one or more real variable and their cyclical components should be determined. In order to achieve this we incorporate behavioural equation to derive the necessary cyclical component, which is not determined by the parameters of production function. Finally, our approach allows dynamic adjustment instead of static computation.

Figure 3 The basic structure of the our alternative approach



Similarly to EC approach, we use the Cobb-Douglas production as the important theoretically motivated part of measuring cyclical position; however, we assume labour-augmented technological progress rather than neutral technological progress, the former being a more acceptable assumption for Hungary

$$Y = S \cdot f(K, TFP \cdot L) \quad (8)$$

where  $S$  is a simple scaling factor now. Another deviation from the EC approach is that we “estimate” TFP with a simple accounting framework instead of estimating Solow residual. As a result, TFP growth can be expressed in the following way<sup>3</sup>:

$$\Delta ffp_t = (\Delta y_t - ((1 - \alpha_t) \Delta k_t - \alpha_t \Delta l_t)) / \alpha_t \quad (9)$$

After having  $TFP$  growth we calculate the level of  $TFP$  and estimate the scaling factor  $S$ . By now potential output and output gap can be computed the normal way (see Figure 9(a)).

Similar to the levels of incomes, the parameters of the production function also identify the relations among output gap ( $y - y^*$ ), wage ( $ws - ws^*$ ) and capital income ( $\pi - \pi^*$ ) gaps. The aggregate output gap equals the weighted sum of labour and capital incomes, where weights are wage ( $\alpha$ ) and capital shares ( $1 - \alpha$ ). As a consequence, output gap can be decomposed the following way:

$$y_t - y_t^* = \alpha_t (ws_t - ws_t^*) + (1 - \alpha_t) (\pi_t - \pi_t^*) \quad (10)$$

where variables with superscript stars denote the potential or trend values of the corresponding variables. Note that any output gap ( $y - y^*$ ) can be used in our method irrespectively of whether it comes from a production function or any other method. For the sake of keeping our approach close to the official method we used Cobb-Douglas production function.

<sup>3</sup> Section VII. 2 shows the derivation of this formula.

In order to incorporate theoretical basis into the analysis, and keep our approach tractable and easily reproducible we develop an alternative framework. Extending the ideas of Laxton and Tetlow (1992), Butler (1996) and Amant and van Norden (1997) with aggregation constraint, we apply multivariate HP filter. Including behaviour-equations is a solution to both the EC approach, i.e. it incorporates theoretical meanings, and the ECB approach since it allows different disaggregated gaps.

$$\Delta ce_i^* = \theta_1 + \theta_2 (ce_{i-1}^* + \rho_1 + \rho_2 ws_{i-1}^*) + \theta_3 \Delta ce_{i-1}^* + \theta_4 \Delta ws_i^* + \varepsilon_i \quad (11)$$

where  $ce$  denotes private consumption expenditure and superscript stars continue to denote the potential of corresponding variables. Obviously, several more behavioural equations can be included. However, due to the fact that (1) the labour-compensation gap determines the direct tax on households, social security contributions and pensions, (2) the profit gap determines direct tax on corporations, there are two potential budgetary elements left. One is the unemployment benefit, the other is indirect taxes on household consumption.

As far as the unemployment benefit is concerned, fortunately, excluding this element is of no consequence, for unemployment benefit in Hungary accounts for only a small percentage of GDP, compared to the other items<sup>4</sup>. Furthermore, unemployment in Hungary, as argued earlier, is effected by several transition shocks, thus there has been no adequate measurement of NAIRU.

Since indirect tax on households is substantial, we incorporate a consumption function, which ensures that the potential values of wages and consumption are computed on theoretical ground. Since the potential value of the wage share is also constrained by equation, (10) the entire system is influenced by a theoretical equation. Finally, the multivariate HP filter identifies the trend values of variables:

$$\min_{\pi^* ws^* ce^*} \left[ \begin{aligned} & \sum (\pi - \pi^*)^2 + \lambda_\pi \sum (\Delta \pi^* - \Delta \pi_{-1}^*)^2 + \\ & \sum (ws - ws^*)^2 + \lambda_{ep} \sum (\Delta ws^* - \Delta ws_{-1}^*)^2 + \\ & \sum (ce - ce^*)^2 + \lambda_{ce} \sum (\Delta ce^* - \Delta ce_{-1}^*)^2 + \\ & \sum \varepsilon_{ce}^2 \end{aligned} \right]$$

In order to make the computation more compact, we embed equation (11) into minimisation problem:

$$\min_{\substack{\pi^* ws^* ce^* \\ \theta_2 \theta_3}} \left[ \begin{aligned} & \sum (\pi - \pi^*)^2 + \lambda \sum (\Delta \pi^* - \Delta \pi_{-1}^*)^2 + \\ & \sum (ws - ws^*)^2 + \lambda \sum (\Delta ws^* - \Delta ws_{-1}^*)^2 + \\ & \sum (ce - ce^*)^2 + \lambda \sum (\Delta ce^* - \Delta ce_{-1}^*)^2 + \\ & \sum [\Delta ce_i^* - (\theta_2 (ce_{i-1}^* + \rho - ws_{i-1}^*) + \theta_3 \Delta ce_{i-1}^* + \theta_4 \Delta ws_i^*)]^2 \end{aligned} \right] \quad (12)$$

---

<sup>4</sup> The ratio of indirect taxes on consumption, social security contributions, direct tax on households, direct tax on corporations and unemployment benefit to GDP are 14%, 10%, 6%, 2% and 0.3% respectively.

The solution to problem (12) with constraint described in equation (10) provides the potential values of variables and the gaps<sup>5</sup>. Based on Table 2, there is no significant difference between the estimated and computed parameters of equation (11), thus our proposed method yields an acceptable result for the behaviour equation.

**Table 2 The estimated and computed parameters of the behavioural equation**

Parameters	Estimation <sup>6</sup>	PF-CMHP	Wald test p-value <sup>7</sup> $\hat{\theta}_i = \theta_i^{MHP}$
$\theta_2$	-0.056	-0.046	0.576
$\theta_3$	0.877	0.791	0.267
$\theta_4$	0.123	0.215	0.266

Now we can compare the advantages and disadvantages of the three methods. The more theoretical basis of the output gap computation is undoubted in the EC approach. That is indeed why we insist on incorporating the production function-driven output gap. Nevertheless, the EC approach does not exploit the information content of wage and capital shares, which is used in estimating the production function. Moreover, it is unable to cope with the various cyclical backgrounds of the same aggregated output gap. The ECB approach handles the latter; however, it is unable to embed theoretical underpinnings and satisfy the aggregation constraint. The importance of disaggregation recognised, our method can provide disaggregated gaps; it is based on theoretically motivated output gap and it fulfils the aggregation requirement.

## II. 4. Introducing prices

Hitherto we have used variables in real terms, however, on the one hand, both tax bases and tax revenues are in nominal terms in reality. As a result, real and nominal cyclical positions may have different signs. Therefore, it seems necessary to introduce prices, that is, to use nominal variables.

Although there are several proposed methods to capture trend or potential price level the concept of potential price level is more dubious. For instance, Buti and Noord (2003) suggested deriving the trend price level from the inflation target of the ECB. Apparently, the ECB inflation target rate cannot be applied to Hungary in the 1990s (the MNB has followed inflation targeting since 2001). Furthermore, the price level, which is consistent

<sup>5</sup> Since numerical optimisation is sensitive to initial values, we chose reasonable values, namely  $\theta_2 = -0.1$ ,  $\theta_3 = 0.6$  and  $\theta_4 = 0.4$ . The initial levels of potential/trend variables were the original levels of the corresponding counterparts.

<sup>6</sup> For the sake of comparison, we also estimate equation (11) by the two-step Engel-Granger method in system (see Section VII. 3. 2). The Wald test  $\rho_2 = 1$  indicates (p value = 0.6) that long-run homogeneity can be maintained, thus we restricted long run wage parameters to 1, and estimated only the long run consumption-wage ratio. Finally, we put it into a short run equation (see equation (21)). The constant in the short run equation should not be significant if the long run equation is estimated correctly. As results underpin our expectation, we do not include short run constant in multivariate HP filter.

<sup>7</sup> The Wald test is carried out by testing whether the estimated parameters in equation (21) differ from the solution to the minimisation problem.

with normal capacity utilisation, should be derived from structural model, where real economy and nominal processes are modelled simultaneously.

There were also proposals to calculate trend inflation using simple statistical methods (Denmark in the annex of Bouthevillain et al (2001), P.Kiss (2002)). The estimations for Denmark were based on HP-filter. They found that price gaps are closer to zero than real gaps, but the price effect is not zero. Their tentative calculations show that the change in the Danish price gap from 1999 to 2000 could lift the cyclical component by 0.3 per cent of GDP. These price developments affected not only the actual inflation but also the composition of the different deflators. This latter effect became important in the case of the real-to-nominal transformation, because deflators have similar composition effect that we showed in the case of real variables.

In this paper we capture the above-mentioned composition effect by the difference between consumer price index (CPI) and GDP deflator. In order to understand the basic idea of our method it should be noted that real variables are first deflated, however, the corresponding deflators differ variable by variable. For instance, corporate profit is usually deflated by GDP deflator while private wages and consumption are deflated by consumer price index. Since budget deficit is compared to GDP, the GDP deflator is the relevant deflator.

To make it clearer suppose that real consumption gap determines the real cyclical position of indirect taxes. Nominal consumption is obtained by multiplying real consumption with consumer price index while indirect taxes are multiplied by GDP deflator. If consumer price index is higher than GDP deflator then nominal indirect taxes are higher than its real counterpart induces.

For instance, consider the Hungarian economy in the mid 90's. Due to the high inflation rate and fiscal tightness, the consumption gap was negative in real terms, while the consumer price index was higher than GDP deflator (see Table 3). As a result, despite the negative consumption gap, the nominal cyclical position of budget revenues was more favourable.

To make the above-mentioned more explicit, consider  $BUD_i^R = (BASE_i^R)^\alpha$  where  $BUD$ ,  $BASE$ ,  $R$  and  $\alpha$  denote  $i^{th}$  budgetary revenue or expenditure, its corresponding base (e.g. personal income tax and wages), variables in real term and the elasticity of budgetary revenue or expenditure to its base respectively. Assume that case where the base is deflated by consumer price index. It is obvious

$$BUD_i^R P^{GDP} = (BASE_i^R)^\alpha P^{CPI} \frac{P^{GDP}}{P^{CPI}} \quad (13)$$

Since  $BUD_i^R P^{GDP} = BUD_i^N$ , where  $N$  denotes variables in nominal term, and  $P^{CPI} = (P^{CPI})^\alpha (P^{CPI})^{1-\alpha}$ , equation (13) has the form  $BUD_i^N = (BASE_i^N)^\alpha P^{GDP} (P^{CPI})^{-\alpha}$ . Taking the logarithm of it we obtain:

$$bud_i^N = \alpha * base_i^N + p^{GAP} \quad (14)$$

where  $p^{GAP} = p^Y - \alpha * p^{CPI}$ . Equation (14) reveals that the difference between GDP deflator and consumer price index multiplied by the budgetary elasticity has to be used so that we obtain the effect of different deflators.

Finally, those budgetary components, which are influenced by this gap, should be identified. Obviously, they are those, which are determined by private wages and consumption, namely, direct taxes on households, pension, social security contribution and indirect taxes on households' consumption. Similar to the cyclical position of real economy and budget deficit, the whole price gap effect is the weighted average of individual elements deflated by consumer price index.

The price effect defined as we did above can partially capture the effects of two factors. First, fluctuations in CPI with a cyclical nature can be revealed. Second, fluctuations caused by discretionary measures can also identified, for example changes in indirect taxes, administered prices or in fixed exchange rates. In some case they can have an effect of real variables in the short-term, and a good example for that is the fiscal consolidation in Hungary in 1995, when surprise inflation was achieved by devaluation and increase in import duties on consumer goods. This had an immediate effect on real variables because nominal wages were not adjusted in the private and public sector.

Of course, the effects of these kind of discretionary measures would better to be estimated directly. Constructing price gaps as a difference between CPI and GDP deflator can remove only a part of these effects, because this gaps only simply smooth the fluctuations in CPI since that is reflected in the fluctuations in GDP deflator at the same time, although with a smaller magnitude.

Another potential problem of defining price gaps as a difference between CPI and GDP deflator comes from the discretionary measures reflected in the deflators of the government consumption and the household consumption in kind (health-care and education). Extraordinary increases of public wage bill<sup>8</sup> were reflected in the above-mentioned deflators, and at the same time GDP deflator, too. In order to filter out these distortions we exclude these extraordinary effects the so-called "corrected GDP deflator".

**Table 3 The composition effect of prices (year on year indices)**

	GDP deflator	Corrected GDP deflator	CPI	Price effect*
1995	27.3	27.3	28.2	0.6
1996	20.6	20.6	23.6	0.7
1997	18.3	18.3	18.3	0.0
1998	12.6	12.6	14.3	0.4
1999	8.3	8.3	10.0	0.4
2000	10.0	10.0	9.8	0.2
2001	8.7	8.7	9.2	0.1
2002	8.6	6.0	5.3	-0.2
2003	7.3	5.9	4.7	-0.2

\* See the above discussion and equation (14).

<sup>8</sup> Wage of public servants increased sharply in 2001 and 2002 while public sector employment increased in 2002 and 2003 in Hungary.

Based on the above equation and Table 3, we use real variables to identify the cyclical position and exploit the additive property of the price effect when calculating the full effect on the budget position.

### **III. Cyclical effects on budget revenues and expenditure**

Tax receipts and social transfers are obviously influenced by cyclical fluctuations in the economic activity. With the cyclical component of the various tax bases and unemployment measured, the next step is the estimation of the respective budgetary elasticities. The applied estimation method of the revenue and expenditure elasticities draws a line between the "cyclical" and the residual non-cyclical components, which are sometimes called structural or underlying components. Before presenting different approaches, we discuss the most important issues.

In the past some elasticities were calculated by using the simple regressions of taxes directly on output. This simple approach has several problems, therefore the OECD employed changes in two steps. First, as already indicated in the previous section, the sensitivity of tax bases to the output has been estimated separately since 2000. (*van den Noord, 2000*)

Second, regarding the elasticities of taxes, the OECD has relied more on the information incorporated in the tax codes since 1995. (*Giorno et al., 1995*) The results of previous regressions indicated the average elasticity over the given period rather than actual elasticity, and at the same time, these elasticities capture not only cyclical influences but also the effects of discretionary policy actions.

#### ***III. 1. The coverage of cyclical adjustment***

It is also important to determine the range of the budget items, which should be cyclically adjusted. The OECD method covers all revenues and, at the same time, only unemployment benefits on the expenditure side.

In some countries, other expenditures are also directly influenced by cyclical fluctuations through different kinds of indexation techniques. The ECB method is more flexible, they analysed these expenditures case by case for each EU country. In our view, indexation techniques do not necessarily grant automatic responses to the cycle because in some cases they can be suspended or augmented by "bonuses" (e.g. in Hungary a 3% extra increase was granted in 2001-2002, and a lump sum one-off payment in 2002). In order to evaluate the binding nature of such an indexation, the track record of their application should be taken into consideration. Interest payments are also influenced by the cycle to some extent, but not automatically.

The majority of government expenditures are also included in legal tax bases, therefore, they increase revenue automatically. The actual effects of discretionary spending can be measured net of taxes. Both tax bases and revenues should be corrected by government outlays. The ECB method also follows this approach. The indirect taxes and contributions paid by the government and direct taxes and contributions paid by public employees are assumed to have zero elasticities, similarly to the corresponding expenditure items. Similarly, the ECB method also adjusts indirect tax revenues with the portion transferred to the EU, because this expenditure item is assumed to have zero elasticity.

At the same time, indirect effects, such as higher indirect taxes paid by households, are still included in the revenue side in the case of fiscal expansion. This suggests that the problem is more common. Cyclical fluctuations affect the budget, which in turn has an influence on the cycle through spending programmes or changes in tax rules<sup>9</sup>. Although taxes and tax bases by government expenditures can be corrected, this kind of "simultaneity" will remain.

### ***III. 2. General remarks on measuring fiscal elasticities***

Tax revenues are influenced by not only changes to tax rules and fluctuations in tax bases in real terms, but also by a number of other – temporary or permanent – factors. Deducting the estimated cyclical component of the budget from the deficit, we arrive at a residual value, which is not necessarily the same as the underlying fiscal position. In the next part of this section we discuss the following scheme of the tax determinants:

#### *The links between tax bases in real terms and tax revenues*

*The effective tax base in real terms → the effective tax base in nominal terms → the legal tax base → the composition effect because of different rates → tax rules → tax revenue*

The dynamics of the effective tax base (according to the national accounts definition) can be quite different in real and nominal terms. Price gaps taken into account, temporary effects can be easily removed, but the effect of the nominal elements (e.g. brackets, ceilings and lump sum payments) of tax rules may require more difficult estimates (see below). Generally speaking, employing the tax base in real terms and updating the elasticities based on nominal tax codes (personal income tax, PIT; social security contribution, SSC) may create inconsistency. For example, nominal developments can be more stable in the short run (in the course of a fiscal year) and surprise in the price gap may affect real tax bases without significant changes in nominal developments.

Dynamics of the legal and the effective tax base can also deviate because of several reasons. (i) The size of tax avoidance and tax evasion may change over time, for example as a reaction to government measures. (ii) Government measures may affect the legal tax base directly, for example increase in the minimum wage automatically affects the legal tax base, but, to some extent, it has no effects on the effective income. Higher minimum wage results in a higher minimum requirement of declared income, in other words, the room for manoeuvre in avoiding tax decreases. (iii) The pattern of the tax and unemployment benefit system sometimes renders the operation of automatic stabilisers asymmetric. For example, in respect of corporate taxation, elasticity depends on the severity of recession, i.e. it exhibits non-linear features. At a certain point (where there are no taxable profits at all) the elasticity becomes zero. Losses have a negative impact on the budget, but only on a deferred basis, as the profit have contrasting economic and legal definitions, and the latter allows for carry forward losses. The status of "entitled for unemployment benefits" is also different from the economic (ILO) definition of unemployment. If the period of

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<sup>9</sup> Even elasticities may change if tax avoidance increases or decreases as a reaction to a government measure.

entitlement to unemployment benefits is shorter than the business cycle, expansions do not reduce expenditures, while recessions increase budget expenditures immediately.

The dynamics of the aggregate tax base may also differ from disaggregated developments. It may have an impact on revenues in the case of the PIT and on the indirect taxes where different tax rates are levied on different income levels or on purchase of specific goods and services. Changes in either income distribution or in the composition of household consumption may depend on the cyclical position. For example, excise duties are levied on a specific range of goods (e.g. fuels, tobacco, etc.), which may be more (or less) volatile than aggregate household consumption.

Tax revenues are determined by changes in tax rules. Most of such changes are treated as a contribution to the underlying fiscal position, except for changes in the progressivity/degressivity of the system of direct taxes on households and social security contributions, which add to the changes in the elasticities of their cyclical component. At the same time, the effects of these measures can be regarded as the effects of discretionary actions rather than cyclical influences. In this respect, it would be useful to determine the definition of the unchanged policy, which is the benchmark case for evaluating actual policies.

As regards the nominal elements of the tax systems, the principle of "no policy changes" does not mean that nominal values should be fixed. In this case, for example, the bracket creeping effect<sup>10</sup> would qualify as a neutral policy. Basically, the neutrality of the nominal elements can be achieved in two different ways. If the government seeks to keep tax burden unchanged, nominal values should be valorised by the expected per capita income each year. In this benchmark case, unit elasticity can be assumed even for the PIT. Our assumption is that the passive policy would be reflected only in the operation of automatic stabilisers of the budget, but it would be possible to design automatic stabilisers in such a manner that budget responses are more than equiproportionate. For example, if the chosen tax system is a progressive one, PIT could grow faster than income. This choice is a discretionary action not only in the first year, but also in the subsequent years, too. If we want to catch this multi-year impact, we have to use unit elasticities between taxes and tax bases. By calculating elasticities from tax codes on an annual basis, our results capture only the effects of the discretionary actions of the year in question.

Another scenario is that the government keeps tax burden unchanged over the cycle, therefore, nominal values increased in line with medium term trends in income. In this case, this would be the benchmark for the no change policy, when the elasticity higher than unity reflects the built-in progressivity of the tax code. This built-in progressivity produces temporarily higher revenue in the case of expanding income in a self-reversing way. In other words, maintaining progressivity may qualify as a discretionary measure, but at the same time, the bracket creeping effect of the progressive tax system may exclude from the underlying fiscal position. This may be the underlying assumption of the OECD and ECB approaches.

Generally speaking, changes in tax rules may have a broad or a narrow definition. The broad definition may include all changes in the effective tax rate, which can be easily calculated ex post. The narrow definition may focus on changes in the obligatory elements

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<sup>10</sup> In the case of increasing taxable income, nominally fixed (or not fully indexed) tax brackets generate revenues more than equiproportionate because of the higher marginal tax rates.

of the tax codes, such as tax rates and automatic tax allowances to certain groups, e.g. employees, families and pensioners. It excludes the "optional" elements of tax codes, which allows for the possibility of receiving tax allowances, but which depends on the decisions of taxpayers. It also excludes changes in the effective tax rates caused by (i) tax avoidance or tax arrears and (ii) composition effects including changes in income distribution or the composition of consumption.

### ***III. 3. The European Commission and OECD approach***

The application of the Commission method, which is built on the same results of OECD method, assumes that the aggregate output gap does not significantly differ from the gaps of tax bases. This approach also assumes that tax codes do not change a lot, since OECD calculations are based on a fixed date of tax codes (1996). There is a further assumption related to the constant composition of the budget because the Commission, unlike the OECD, calculates an aggregate sensitivity parameter of the budget, weighting the OECD elasticities by fixed weights of budget items.

The sensitivity parameters of the budget applied by the Commission are based on the budgetary elasticities calculated by the OECD. The OECD method calculates elasticities for all tax receipts on the revenue side and for unemployment benefit on the expenditure side. Revenues are classified into four groups, namely indirect taxes, direct taxes on corporations, direct taxes on households and social security contributions (paid by employers and employees).

In the case of direct taxes on households and social security contributions, the OECD approach has taken into account tax codes since 1995. Average and marginal rates adjusted according to social background were systematically calculated for each level of income. The ratio between the weighted averages of adjusted marginal and average rates provides the elasticities of receipts to gross earnings. Weights of the various income categories are calculated on the basis of an estimated income distribution. In 2000 these calculations were updated on the basis of the 1996 tax codes.

Instead of using simple regressions for indirect and direct taxes on corporations, the new OECD method assumes unit elasticities between taxes and tax bases, and concentrates on elasticities between tax bases and the output. In the case of unemployment benefits, the OECD also assumes unit elasticity between expenditures and unemployment.

It is not easy to apply the OECD method to Hungary, since the systematic OECD approach of calculating the effects of tax codes cannot be reproduced. Fortunately, we have a full set of data on personal income tax in 2000-2002, including a breakdown by income categories, elements of the tax base and different tax allowances. In other words, we have actual data on the distribution of taxable income and the average tax burden, therefore we had to estimate only 'effective' marginal rates. In the case of marginal rates we focus on the wage component of the taxable income, the other income is less elastic, they rather follow some 'minimum requirement' of declared income. We calculate these marginal rates for each income level on the basis of the marginal statutory tax rates, reduced by (i) the PIT allowance of contributions paid to the Pension Fund, which contribution is proportional to income up to a ceiling, (ii) the tax allowance of employees, which is phased out gradually in higher income levels, (iii) the tax allowance of pensions until 2001, which income is indexed to wages and inflation and (iv) the tax allowance for families. This latter has fixed statutory amounts on the basis of the number of children, but the effective amount limited by the tax obligations of the individual taxpayer. In other

words this allowance exhibits zero elasticity to income at medium and higher income levels, but at low income levels an extra unit of income would increase the effective allowance up to the ceiling. There are also ‘optional’ tax allowances, such as tax credits on various kinds of preferred savings or housing loans, which have similar ceilings. In this case we assume that an additional unit of income cannot change the size of that allowances. It can also distort our results in a few cases, when taxpayers cannot fully benefit from these allowances because of the low income level to which they have. We assumed that this effect was negligible.

**Table 4 Fiscal elasticities in the Commission approach**

	2000	2001	2002	2003
Direct tax on households (PIT)	1.39	1.24	1.55	1.55*
Social security contributions	0.891	0.895	0.898	0.920
Unemployment benefit	1.0	1.0	1.0	1.0
Indirect taxes	1.0	1.0	1.0	1.0
Direct tax on corporations	1.0	1.0	1.0	1.0

\*Not available, no changes in progressivity assumed w.r.t. 2002.

The elasticity of PIT varied over the period, not only tax rules but also the distribution of the taxable income changed, as the minimum wage increased very significantly in 2001 and 2002. From 2002 the definition of income excludes pensions and at the same time the tax allowance of pensions was abolished. This measure had no impact on PIT revenue, but progressivity was increased because of the marginal tax burden decreased less than the average tax burden. In the last quarter of 2002, the government introduced a “no tax on minimum wages” principle by increasing the normal allowances for employees up to the maximum, this allowance phased gradually out in higher income levels. Naturally, it had a full year impact in 2003.

The elasticity of social security contributions was calculated in a manner that the nominal elements of the tax code had been taken into account. First, pension fund contributions paid by employees have a nominally determined ceiling. A 1%-range around this ceiling and the weight of the relevant income were determined on the basis of the income distributions which had been used in PIT calculations. Second, remaining unaffected by changes in wage income, contributions include a per capita payment by employers. The average rate is included, but the marginal one excludes this lump sum contribution. Therefore, we calculated a ratio between the other contributions and total contributions. Finally, elasticity was calculated as a weighted average of these factors.

In order to evaluate the above-described elasticities differently, we estimated these figures with standard time-series econometric techniques<sup>11</sup>. First, based on the estimation results, the elasticity of personal income tax to private wages is 1.28, which differs significantly from unit elasticity. Second, we also find that the elasticity of social security contribution to compensation is 0.90. This latter result is close to the previous estimation and confirm each

<sup>11</sup> Estimation details are enclosed in Section VII. 3. 3.

other. In addition, both valued-added tax and corporate income tax seem to move in line with consumption expenditure and profit respectively with unit elasticities. Finally, the estimation results of the elasticities of unemployment benefits and some indirect taxes (local business tax and customs duties) which were changed frequently were significantly different from the unit elasticity assumed. To sum up all estimation the elasticity of budget deficit to output is 0.39, which is close to the 0.4 estimation of Coricelli and Erconali (2002).

### ***III. 4. The ECB approach***

In the ECB approach elasticities are either calculated from tax codes, similarly to the OECD approach, or estimated with economic regressions, depending on the specific circumstances of the different countries. In the case of PIT and SSC, we chose the same elasticities as were calculated in the OECD (Commission) approach.

**Table 5 Fiscal elasticities in the ECB approach**

	2000	2001	2002	2003
Direct tax on households (PIT)	1.43	1.40	1.55	1.55*
Social security contributions	0.891	0.895	0.898	0.920
Unemployment benefit	1.0	1.0	1.0	1.0
Pensions	0.5	0.5	0.5	0.5
Indirect taxes on household consumption	1.0	1.0	1.0	1.0
Direct tax on corporations	1.0	1.0	1.0	1.0
Other major indirect taxes	1.0	1.0	1.0	1.0

\*Not available, no changes in progressivity assumed

At the same time, the coverage of the budget items involved in the cyclical adjustment is quite different in the ECB compatible and OECD (Commission) type methods. Applying the ECB method, we had several options at our disposal to define the most appropriate coverage. In Hungary the cycle affects not only unemployment benefits on the expenditure side, but also pensions. Pension increases depend on per capita net (after-tax) real wage increases, so these expenditures are not independent of the cycle. However, by establishing links with the cycle, we confine wage increase to private wages.

In the case of revenues, we follow the approach, which corrects revenues with those parts which were paid by the government, because their counterparts in the expenditure side were considered as non-cyclical. The degree of the discretionary spending policies can be captured also in net terms, excluding taxes. This method also adjusts indirect tax revenues by the part, which is transferred to the EU, as this expenditure item is assumed to have zero elasticity.

We divide the broad category of indirect taxes, distinguishing between (i) VAT and excise duties linked to consumption, (ii) value added based local business tax and import duties linked to economic growth, (iii) other specific taxes on gambling, mining and consumption of specific goods. The third category has no direct links with macroeconomic developments, therefore these items are assumed to exhibit zero elasticities to them.

### ***III. 5. Our approach behind the PF-CMHP method***

Since we apply the most appropriate coverage of the cyclically adjusted budget items in the adaptation of the ECB approach, we employ the same budgetary categories in our method (except for unemployment benefits).

**Table 6 Fiscal elasticities in the our approach**

	2000	2001	2002	2003*
Direct tax on households (PIT)	1.0	1.0	1.0	1.0
Social security contributions	1.0	1.0	1.0	1.0
Pensions	0.5	0.5	0.5	0.5
Indirect taxes on household consumption	1.0	1.0	1.0	1.0
Direct tax on corporations	1.0	1.0	1.0	1.0
Other major indirect taxes	1.0	1.0	1.0	1.0

The elasticities are the same as in the other approaches, except for direct tax on household income and social security contributions. In our approach the benchmark case of the unchanged policy is the constant tax burden for each year, i.e. nominal elements are valorised by the growth rate of the per capita income. Under this assumption, unit elasticity is assumed for the PIT and social security contributions. (In the ECB approach the weighted elasticity of the PIT and SSC is not significantly different from the unit elasticity.) Practically, this approach removes potential inconsistency between real variables and the nominal elements of the tax code without introducing a price gap. For example, real wages may decrease temporarily because of short-term "surprise" inflation. In such a case, the progressivity of the PIT would suggest a more than equiproportionate negative budgetary effect. In fact, the price gap taken into account, nominal wage growth may still have a more than equiproportionate positive budgetary effect.

In the case of price gaps, we employ the same elasticities, but the budget items are corrected with lump sum receipts and excise duties levied on real quantities. One can argue however, that our calculations should include the primary expenditures of the budget, which can be adjusted by discretionary measures according to the expected developments in the price gap. In our approach these expenditure items are assumed to have zero elasticities to the price gap defined as a difference of CPI and GDP deflator, because they possibly react differently to the developments of the CPI and those of the GDP deflator. The reason is that the composition of the expenditure items - namely wages, purchase of goods and services, investments, capital and current transfers - is closer to the composition of the GDP than those of the household consumption. As the only exception the CPI-indexed part of the primary expenditures (pensions) were taken into account, but the other expenditures were assumed to be fully compensated only to the fluctuations in the GDP deflator. The full compensation to the CPI would immediately require discretionary measures and this assumption was not confirmed by our past experiences. We also exclude the interest expenditures, which can react to the expected price gap but their elasticities would be difficult to be estimated.

#### IV. Results – the cyclical component of the fiscal deficit

The differences between the individual estimated cyclical components based on the Commission method and the ECB approach can be regarded as the composition effect of the output gap, because the major difference is a disaggregated approach of tax bases. The other parameters do not differ so greatly, only the coverage of the adjusted budget items differs, while the selected fiscal elasticities are the same. The coverage difference has an effect on budgetary sensitivity, rendering the sensitivities in the ECB approach smaller. The reason for this is that revenues exclude the tax content of the budget expenditures and, at the same time, sensitivity decreases, since some indexed expenditures (pensions) also react automatically to macroeconomic developments.

The cyclical adjustment proposed by us is, in principle, closer to what is proposed by the ECB approach. The coverage of budget items is the same, and the overall fiscal elasticity is not far from the elasticity employed in the ECB approach. Therefore the difference in the results of the cyclical component can be interpreted as (i) the difference between long and short-run adjustment caused by the dynamic nature of economy, (ii) difference between the individual consumption gaps explained by income position and estimated by filters.

**Table 7 Cyclical component of the budget deficit\***

	Cyclical components			Cyclical components with price effect		
	EC	ECB	PF-CMHP	EC	ECB	PF-CMHP
1995	0.0	-0.4	0.1	0.6	0.2	0.7
1996	-0.4	-1.0	-0.6	0.3	-0.3	0.1
1997	0.1	-0.9	-0.3	0.1	-0.9	-0.3
1998	0.3	-0.4	0.0	0.7	0	0.4
1999	-0.2	0.1	-0.1	0.2	0.5	0.3
2000	0.1	0.2	0.0	0.3	0.4	0.2
2001	0.1	0.0	-0.1	0.2	0.1	0
2002	0.1	0.5	0.4	-0.1	0.3	0.2
2003	-0.2	0.8	0.4	-0.4	0.6	0.2

\* As the percentage of GDP

Table 8 clearly reveals the most important difference between aggregated (EC) and disaggregated (ECB, PF-CMHP) approaches. Due to the negative output gap in last year EC method suggests that the cyclically adjusted fiscal deficit was smaller, while ECB and PF-CMHP show the opposite. Knowing that domestic demand was definitely above its potential value, the disaggregated approach provides plausible result. Apparently, differences between the results of the ECB and those of our approach were not so great, except for the first period. In spite of the relatively low difference, trends in the cyclical component suggest different stories for the past years. Using these cyclical components and price gap cyclically adjusted fiscal deficit can be calculated.

**Table 8 Cyclically adjusted primary ESA deficit\***

	Budget deficit**	CAB			CAB with price effect		
		EC	ECB	PF-CMHP	EC	ECB	PF-CMHP
1995	1.3	1.3	1.7	1.2	0.7	1.1	0.6
1996	4.1	4.5	5.1	4.7	3.8	4.4	4.0
1997	2.7	2.6	3.6	3.0	2.6	3.6	3.0
1998	-0.4	-0.7	0.0	-0.4	-1.1	-0.4	-0.8
1999	1.9	2.1	1.8	2.0	1.7	1.4	1.6
2000	2.7	2.6	2.5	2.7	2.4	2.3	2.5
2001	0.4	0.3	0.4	0.5	0.2	0.3	0.4
2002	-5.1	-5.2	-5.6	-5.5	-5.0	-5.4	-5.3
2003	-1.8	-1.6	-2.6	-2.2	-1.4	-2.4	-2.0

\* Deficit corrected with interest expenditure and cyclical component, as the percentage of GDP.

\*\* Primary ESA; source: own estimations for 1995-1997, various EDP reports for 1998-2003.

**Table 9 Cyclically adjusted primary SNA deficit\***

	Budget deficit**	CAB			CAB with price effect		
		EC	ECB	PF-CMHP	EC	ECB	PF-CMHP
1995	0.3	0.3	0.7	0.2	-0.3	0.1	-0.4
1996	2.7	3.1	3.7	3.3	2.4	3.0	2.6
1997	0.9	0.8	1.8	1.2	0.8	1.8	1.2
1998	0.4	0.1	0.8	0.4	-0.3	0.4	0.0
1999	0.7	0.9	0.6	0.8	0.5	0.2	0.4
2000	1.2	1.1	1.0	1.2	0.9	0.8	1.0
2001	-0.6	-0.7	-0.6	-0.5	-0.8	-0.7	-0.6
2002	-4.9	-5.0	-5.4	-5.3	-4.8	-5.2	-5.1
2003	-4.7	-4.5	-5.5	-5.1	-4.3	-5.3	-4.9

\* Deficit corrected with interest revenue, expenditure, net payments of the central bank as the percentage of GDP.

\*\* Source: [http://www.mnb.hu/dokumentumok/hu1001\\_fiskalis.xls](http://www.mnb.hu/dokumentumok/hu1001_fiskalis.xls)

Since CPI was higher than GDP deflator in 90s' cyclically adjusted budget deficit shows even worse structural fiscal stance. On the other hand, in 2002 and 2003 CPI was lower than GDP deflator thus cyclical components, suggested by real variables, were also lower. It have to be noted that results from price gap should be interpreted carefully because there is only arbitrary way to filter out discretionary effect of fiscal policy on GDP deflator. Nevertheless the inclusion of price gap helps to depict the correct cyclical position of fiscal deficit.

The different indicators suggest substantially different stories in the case of the fiscal consolidation in 1995-1996 in Hungary. As a first step of the measures a surprise inflation was achieved by devaluation and increase in import duties on consumer goods. This had a significant effect on real variables immediately because nominal wages were not adjusted in the private and public sector. In other words a sizeable reallocation between household income (and consumption) and profits (and investment) was achieved for the benefit of latter. The aggregate EC method seems to be unable to capture this change, the ECB method shows an immediate and strong impact on the budget, while our approach suggests a significant, but less severe impact with one year lag. Taking into account the price effect however, the EC method would reflect a positive budget component, the ECB method

would turned out to be less negative, while our method suggests that this budget component could have closer to zero assuming the one year lag.

In 2002-2003 the aggregate EC method would indicate a small negative cyclical component. On the other hand, disaggregated methods suggest a significant positive cyclical component. The ECB method indicates a higher impact on the budget, while our method shows a more moderate impact. Taking into account the price effect, the results of the corrected EC method become more negative. The positive cyclical component estimated by the disaggregated methods would be less significant. It can be interpret as the temporary positive impact of the cyclical fluctuations of real variables will disappear over the cycle, but temporary negative impact of the price gap will also be self-reversed in the medium-term. These results have different policy implications, for example in the case of plans for future tax cuts.

## **V. Conclusions**

“Atypical” cyclical circumstances in Hungary taken into consideration, it is not surprising that the aggregate output gap methods such as the EC approach provide an inaccurate picture of the cyclical component of the budget, sometimes even with the wrong sign.

Alternative disaggregated methods have an additional advantage, allowing for the possibility of removing the direct “automatic” effects of government spending on the revenue side. However, the indirect effects of those expenditures on boosting household consumption cannot be filtered out easily.

The results of the two alternative disaggregated methods are not very different during the period as a whole. Unlike the ECB method, the PF-CMHP approach has a few favourable properties. First and foremost, our method is able to incorporate theoretically motivated assumptions. In addition to the production function, disaggregated gaps are also driven by the behavioural equation. Secondly, aggregation constraint is satisfied in the PF-CMHP approach, while it is violated in the ECB method. Finally, due to international applicability and comparability, our method remains tractable and is easy to reproduce.

Taking into account other difficulties mentioned in the introduction, the cyclical component is the only one of the temporary influences, which should be removed from the budget balance in order to assess the underlying fiscal situation or the degree of discretionary policies. In other words, CABs should be corrected with other influences (like inflation) and/or a part of the discretionary component, which is temporarily positioned inside or outside the budget accounts. In order to emphasise these necessarily corrections, we focus on cyclical components (cc) than rather CABs or CAPBs themselves.

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## VII. Appendix

### VII. 1. Log-linearization and the optimal value of $\lambda$ in HP filter

Mohr (2003) argues that the HP filter is linear. This property ensures theoretical relationship by the fact that the disaggregated HP filtered gap precisely sums up to the aggregate gap. Even though the HP filter is linear, this characteristic cannot be exploited in economic time series. In order to substantiate this, we prove that economic time series should be logarithmized in the HP filter, and as a consequence, aggregation constraint is not satisfied. First, let us consider the standard form of the HP filter:

$$\min_{y^*} \left\{ \sum_{t=1}^T (y_t - y_t^*)^2 + \lambda \sum_{t=2}^{T-1} ((y_{t+1}^* - y_t^*) - (y_t^* - y_{t-1}^*))^2 \right\}$$

where  $\sum_{t=2}^{T-1} ((y_{t+1}^* - y_t^*) - (y_t^* - y_{t-1}^*))^2$  term ensures the smoothness of the trend component. Note that this term is applicable to only I(1) variables, where the first difference is stationary. If  $y_t$  grows exponentially, which is true for most economic time series, then the standard smoothness term is inappropriate, since difference increases in time. As a consequence, the weight of differences in the optimisation problem becomes increasingly high, and distorts the estimation. The longer the time series are, the larger the differences and the size of distortion. The following example outlines this effect. Consider an exponentially growing time series:  $y_t = (1 + g)^t y_0$  and multiply it by a three-year long, two-percent peak gap:

Figure 4 Distortion in HP filtered exponential time series

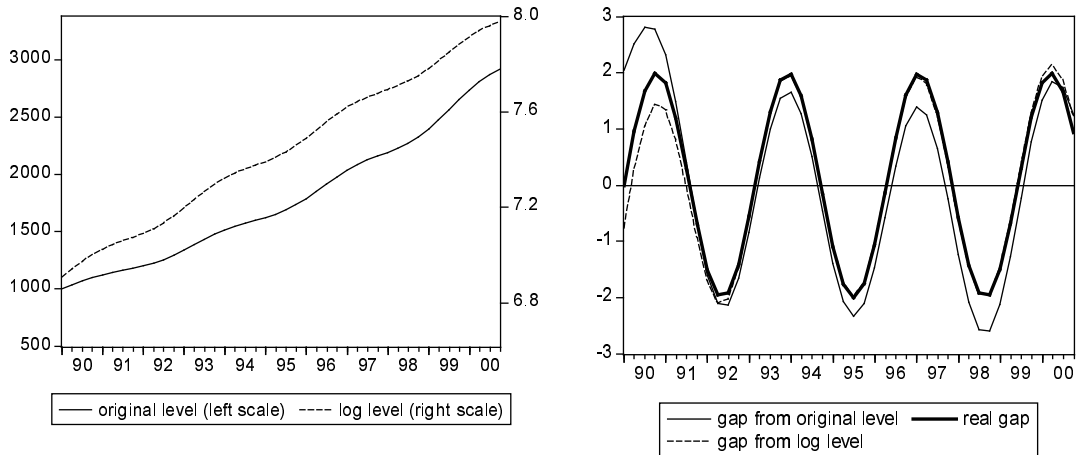
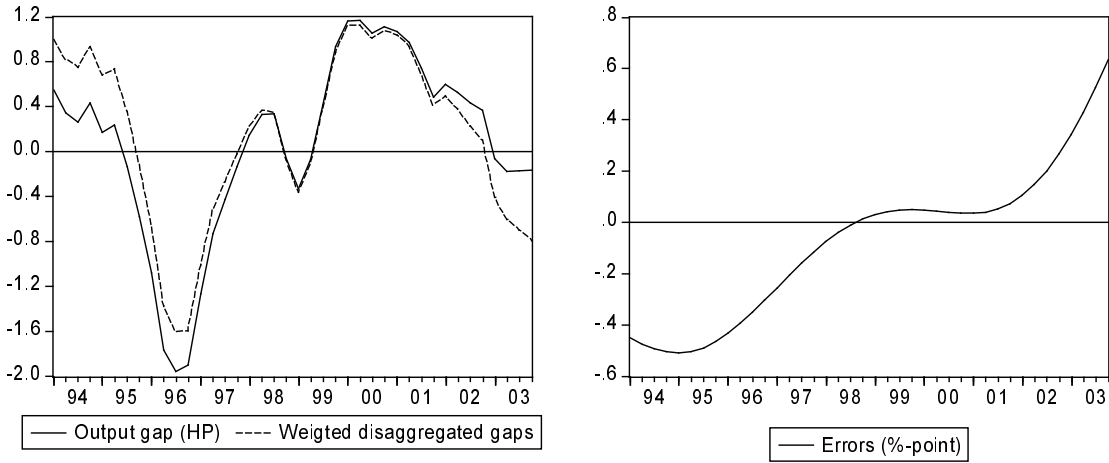


Figure 4 clearly reveals that economic time series, such as GDP, private wages, consumption etc, cannot be HP filtered without log-linearizing, which was what we want to prove.

By now it is obvious why the linear characteristic of the HP filter cannot satisfy the aggregation constraint in the case of economic time series. Even if  $C_t = A_t + B_t$  is true, then  $c_t \neq a_t + b_t$ , where small-case letters denote the natural logarithm of variables, and thus, the same is true for HP filtered time series. To present this phenomenon, we break down the output into labour income and profit, using wage ( $\alpha$ ) and profit shares ( $1-\alpha$ ). Figure 5 plots the HP-filtered aggregated output gap, weighted labour income and profit gaps for Hungary<sup>12</sup>. It is apparent that the size of the error is not negligible. Results do not become better if we examine longer time series of developed economies (see Figure 7). To sum up HP filter is not only non-linear in the case of log-level economic time series, which is obvious, but also the size of the error is considerable.

Figure 5 Violation of aggregation constraint in the case of Hungary



Another problem is related to the proper value of  $\lambda$ . We will show that optimal  $\lambda$  parameter is not independent of growth rate if we use the levels of variables. However, it is independent in the case of log-level time series.

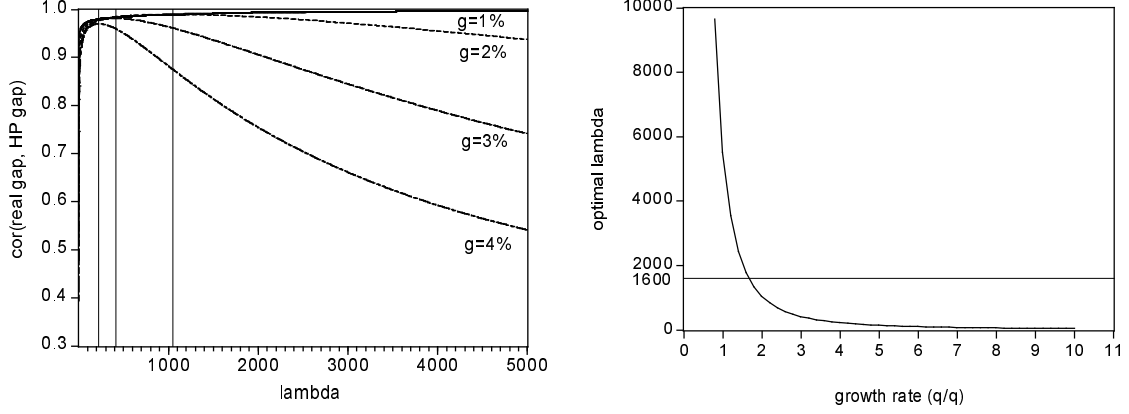
We simulate time series with different growth rates and add the same gaps to them. Using these time series, we compute HP gaps by different lambdas, and find  $\lambda$  where the correlation between real gap and HP is maximal.

Simulation results underpin our intuition, namely that the higher the growth rate is, the smaller is the value of the optimal lambda, e.g. 1% quarterly growth rate requires  $\lambda=5512$ , while lambda is only 1048 if the growth rate is 2% (see the right-side panel of Figure 6). This is obvious if we bear it in mind that a smaller lambda allows the HP trend to get closer to the exponential pattern. The problem is that  $cor(real\ gap, HP\ gap)$  has a maximum value depending on lambda. However, it changes case by case (see the left panel of Figure 6). In the case of log-linearized time series,  $cor(real\ gap, HP\ gap)$  grows infinitely, since the underlying trend is linear, which in turn can be captured by  $\lambda \rightarrow \infty$ . The advantage of

<sup>12</sup> Due to the endpoint problem we apply HP filter for data from 1991 and extended to 2005 using the forecasts of Quarterly Report of Inflation (February 2004).

latter is that the same “efficiency” can be obtained for all log-linearized economic time series without a  $\lambda$  parameter having to be determined.

Figure 6 Optimal value of  $\lambda$



The left panel shows the correlation between the original gap and the one derived from the HP filter as a function of lambda. The right panel displays the optimal lambda, which provides a maximum correlation between the original gap and the HP one as a function of growth rate.

## VII. 2. An alternative way of deriving TFP

Along with the EC approach, we use the Cobb-Douglas production as an important theoretical part of measuring cyclical position, however, we assume labour-augmented technological progress rather than neutral technological progress, as the former is a more acceptable assumption in the case of Hungary

$$Y = S \cdot f(K, TFP \cdot L) \quad (15)$$

where  $S$  is a simple scaling factor now. Another deviation from the EC approach is that we “estimate” TFP by a simple accounting framework instead of estimating Solow residual. For the sake of simple notation, denote  $H$  the effective labour i.e.  $H = TFP \cdot L$ . The total derivative of equation

$$dY = \frac{\partial Y}{\partial K} dK + \frac{\partial Y}{\partial H} dH \quad (16)$$

assuming that the marginal production of effective labour and capital is equal to the average wage and the user cost of capital i.e.  $\partial Y / \partial K = user$  and  $\partial Y / \partial H = w$  and doing some algebra we obtain

$$\frac{dY}{Y} = \frac{user \cdot K}{Y} \frac{dK}{K} + \frac{w \cdot H}{Y} \left( \frac{dL}{L} + \frac{dTFP}{TFP} \right) \quad (17)$$

Based on national accounts, substitute  $user \cdot K / Y$  for  $1 - \alpha$  and  $w \cdot H / Y$  for  $\alpha$  into equation (18) and rearrange it, we get the growth of TFP.

$$\frac{dTFP}{TFP} = \left( \frac{dY}{Y} - \left( (1-\alpha) \frac{dK}{K} - \alpha \frac{dL}{L} \right) \right) / \alpha \quad (18)$$

By introducing time varying variables and using simpler notation, we obtain

$$\Delta \ln p_t = (\Delta y_t - ((1-\alpha_t)\Delta k_t - \alpha_t \Delta l_t)) / \alpha_t \quad (19)$$

using (19), we can compute the growth rate of TFP and its level .

### VII. 3. Estimation results

#### VII. 3. 1. Cobb-Douglas production function

As the first step, we estimate the standard Cobb-Douglas production function without any restrictions. Then we impose  $\alpha + \beta = 1$ , re-estimate the function and finally we apply expertise capital-labour share:

**Table 10 Cobb-Douglas production function**

$$y_t = a + \alpha l_t + \beta k_t + \varepsilon_t$$

	$y$	$y$	$y$
<i>const.</i>	-2.98 (0.70)	-1.53 (0.02)	-0.81 (0.01)
$l$	0.26 (0.10)	0.06 -	0.65 -
$k$	0.92 (0.02)	0.94 (0.01)	0.35 -
Wald test $\alpha + \beta = 1$	0.045	-	-

\*Standard errors are in brackets

where  $y$ ,  $l$  and  $k$  denote the natural logarithm of GDP, employment and capital stock<sup>13</sup> respectively. As argued, the constant input share cannot be maintained in Hungary, thus we invoke the time varying parameter estimation of capital share:

$$y_t = -0.812 + (1 - \beta_t)l_t + \beta_t k_t + 0.034$$

$$\beta_t = 0.00019 + 1.011\beta_t + 6.03E-08$$

where standard errors are in brackets. Note that capital share seems to follow unit root process with drift, which is an acceptable result if it increases steadily during the test period.

<sup>13</sup> We used capital stock estimation of Pula (2003).

### VII. 3. 2. Cyclical elasticities of the real economy

As mentioned earlier, there are four real-economy variables that determine cyclical position. Since we tend to distinguish between the long-run and the short-run it follows that the error correction model is estimated by using the two-step Engel-Granger method. As the residuals of these equations can be correlated, we test explicitly standard OLS, or else seemingly unrelated regression (SUR) should be used.

**Table 11 Long run parameters of real economy**

	$x_t^i = \rho_1 + \rho_2 y_t$		
	$wp$	$ce^*$	$\pi$
<i>const.</i>	-3.63 (0.34)	-0.55 (0.71)	-1.84 (0.64)
$y, *pdi$ in $ce$ equation	1.06 (0.04)	1.05 (0.10)	1.05 (0.08)
Wald test p-value of $\rho_2 = 1$	0.21	0.60	0.57
<i>const.</i>	-3.19 (0.00)	-0.18 (0.01)	-1.47 (0.01)
$y, *pdi$ in $ce$ equation	1 -	1 -	1 -

\*Standard errors are in brackets. Estimation method is SUR suggested by log-likelihood ratio test.

where  $wp$ ,  $ce$ ,  $\pi$ ,  $pdi$  and  $y$  denote the natural logarithm of private wages, private consumption, corporate profit, personal disposable income and GDP in real terms. Since labour force is relatively fixed, the elasticity between average private wages ( $wp$ ) and personal disposable income ( $pdi$ ) equals one.

The short run parameters are estimated in the second step of the Engel-Granger method. It should be noted that these variables are endogenous with each other influencing the estimation process in addition to the fact that the residuum of equations can be correlated. Applying instrumental variables and the two-stage least squares method (TSLS) we cope with the problem of endogeneity problem. The three stage least squares method (3SLS) is able to handle both endogeneity and the correlation among residuum. Based on log-likelihood ratio test, the following system was estimated by 3SLS:

$$\Delta wp_t = 0.002 - 0.041(wp_{t-1} + 3.19 - y_{t-1}) + 0.499 wp_{t-1} + 0.299 y_t, \quad \bar{R} = 0.425 \quad (20)$$

(0.002)      (0.058)      (0.128)      (0.354)

$$\Delta ce_t = 0.001 - 0.056(ce_{t-1} + 0.18 - pdi_{t-1}) + 0.877 ce_{t-1} + 0.123 pdi_t, \quad \bar{R} = 0.803 \quad (21)$$

(0.001)      (0.018)      (0.076)      -

the short run parameters of profit equation was not acceptable thus:

$$\Delta \pi_t = 0.010 - 0.554(\pi_{t-1} + 1.47 - y_{t-1}), \quad \bar{R} = 0.248 \quad (22)$$

(0.005)      (0.184)

### VII. 3. 3. Cyclical elasticities of budget revenues and expenditures

This section displays the estimated budget sensitivities to taxes. In order to get econometrically correct results, we also apply error correction models to estimate elasticities. Compared to the real economy, there is an additional problem, namely that changing tax rates alter the relationship between tax bases and budget revenues<sup>14</sup>. So as to avoid this distortion, we introduced additional variables that contain the effective tax rates filtering out the effect of tax rates on revenues. Unlike personal income tax (*ptax*), social security contributions (*ssc*) and corporate tax (*ctax*), value-added tax (*vat*) had not been changed significantly before 2003. As a result, it is not necessary to cope with dummy in this case.

**Table 12 Long run parameters of budget elasticities**

$budget\ revenue_t^i = \rho_1 + \rho_2 tax\ base_t + D_t^{tax\ rate}$				
	<i>ptax</i>	<i>vat</i>	<i>ssc</i>	<i>ctax</i>
<i>const.</i>	-6.59 (0.54)	-1.38 (1.05)	-1.30 (0.58)	-2.94 (0.85)
<i>tax base*</i>	1.28 (0.08)	1.00 (0.15)	0.90 (0.06)	1.02 (0.13)
<i>tax rate dummy</i>	0.76 (0.07)		0.01 (0.00)	0.04 (0.01)
Wald test p-value of $\rho_2 = 1$	0.00	0.99	0.14	0.89
<i>const.</i>		-1.39 (0.01)		-2.82 (0.08)
<i>tax base*</i>		1		1
<i>tax rate dummy</i>		-		0.04 (0.00)

\* Tax bases are average private wages, private consumption and compensation in private sector and profit. Standard errors are in brackets.

It is worth noting that unit elasticity is clearly accepted in the case of value-added tax and corporate tax. Although the Wald test formally accepts the unit elasticity of social security contributions, it cannot be accepted theoretically. In order to decide whether the estimated long run equations are appropriate, we have to estimate the short run ones.

$$\Delta ptax_t = -0.004_{(0.004)} - 0.167_{(0.123)} (ptax_{t-1} + 6.59 - 1.28wp_{t-1} - 0.761D_{t-1}^{taxrate}) + 0.640_{(0.302)} wp_t \quad (23)$$

$$\Delta vat_t = -0.036_{(0.016)} - 0.703_{(0.179)} (vat_{t-1} + 1.39 - ce_{t-1}) \quad (24)$$

$$\Delta ssc_t = 0.009_{(0.002)} - 0.810_{(0.159)} (ssc_{t-1} + 1.30 - 0.9(wp_{t-1} eep_{t-1}) - 0.01D_{t-1}^{taxrate}) \quad (25)$$

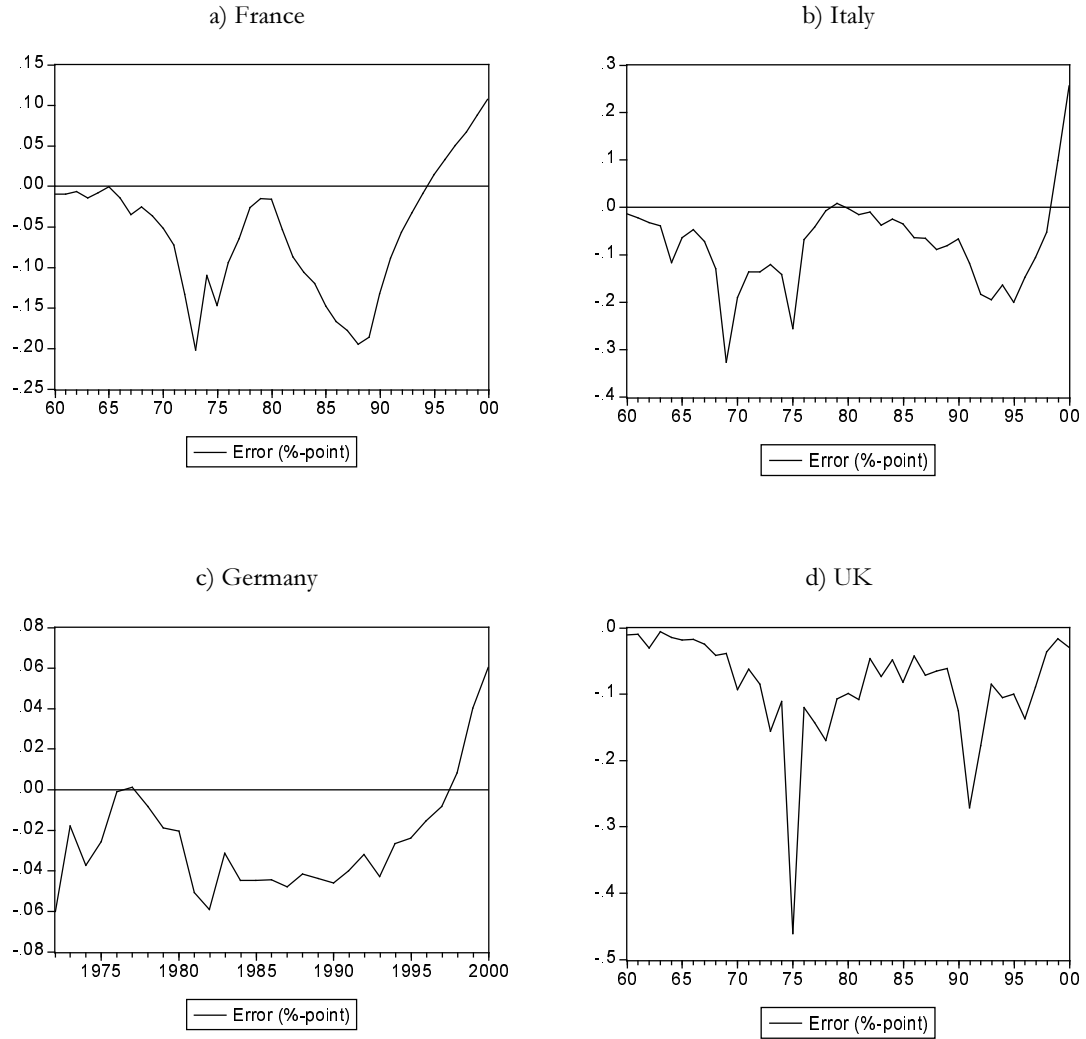
<sup>14</sup> Boije (2004) mentions this problem as the result of usage of annual data since estimation requires large time-span and tax and expenditure rules must be changed in long-run. In fact, the presence of this problem is not depend on time-span it occurs whenever tax rule is changed.

$$\Delta ctax_t = -\underset{(0.012)}{0.004} - \underset{(0.061)}{0.346}(ptax_{t-1} + 2.82 - y_{t-1} - 0.04D_{t-1}^{taxrate}) \quad (26)$$

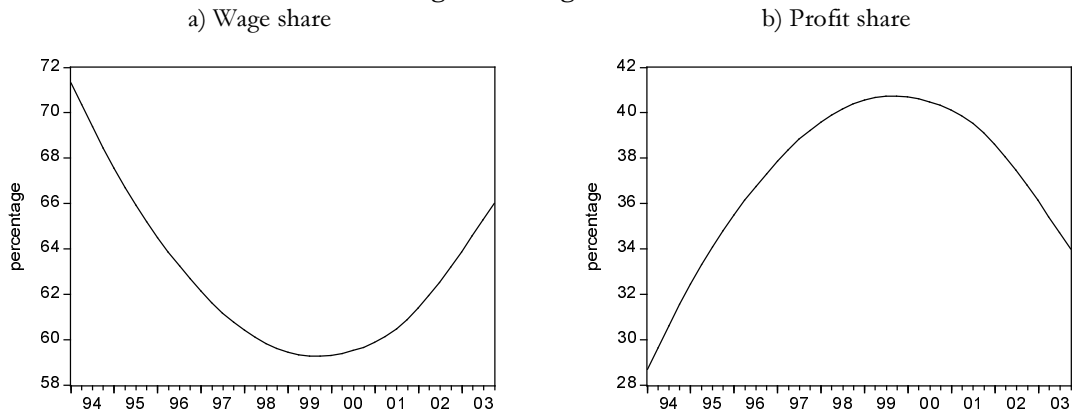
The short-run parameters have negative signs and reasonable magnitudes, thus we can conclude that the estimated long-run parameters describe the sensitivities of budget revenues.

## VII. 4. Figures

**Figure 7 Violation of aggregation constraint in some selected countries**

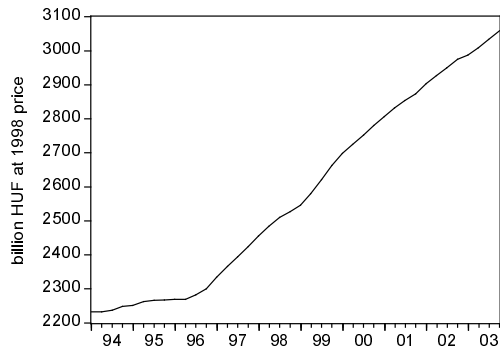


**Figure 8 Hungarian data**

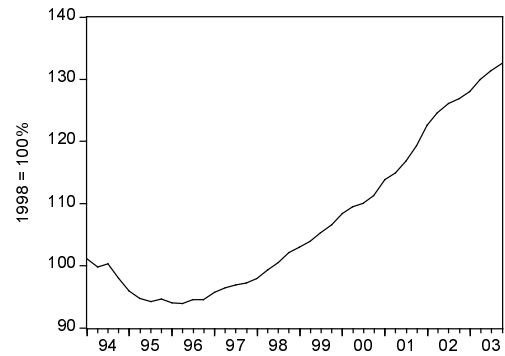


**Figure 8 Hungarian data (cont.)**

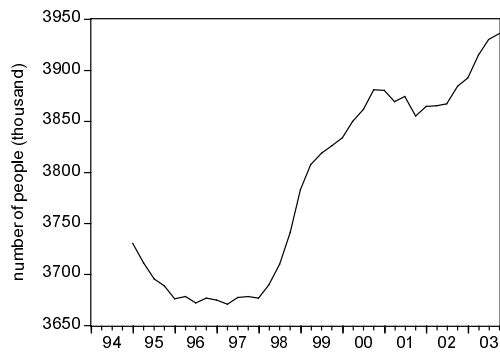
c) Output



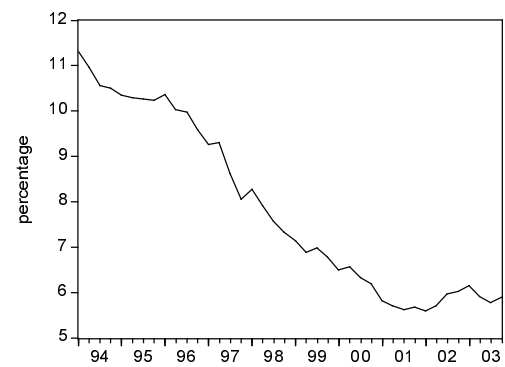
d) Average real wages in private sector



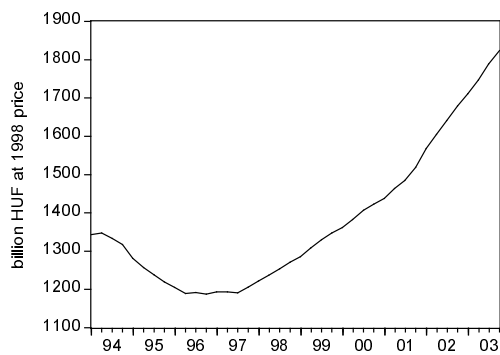
e) Employment



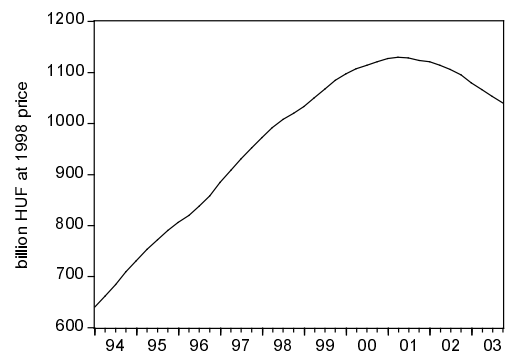
f) Unemployment rate



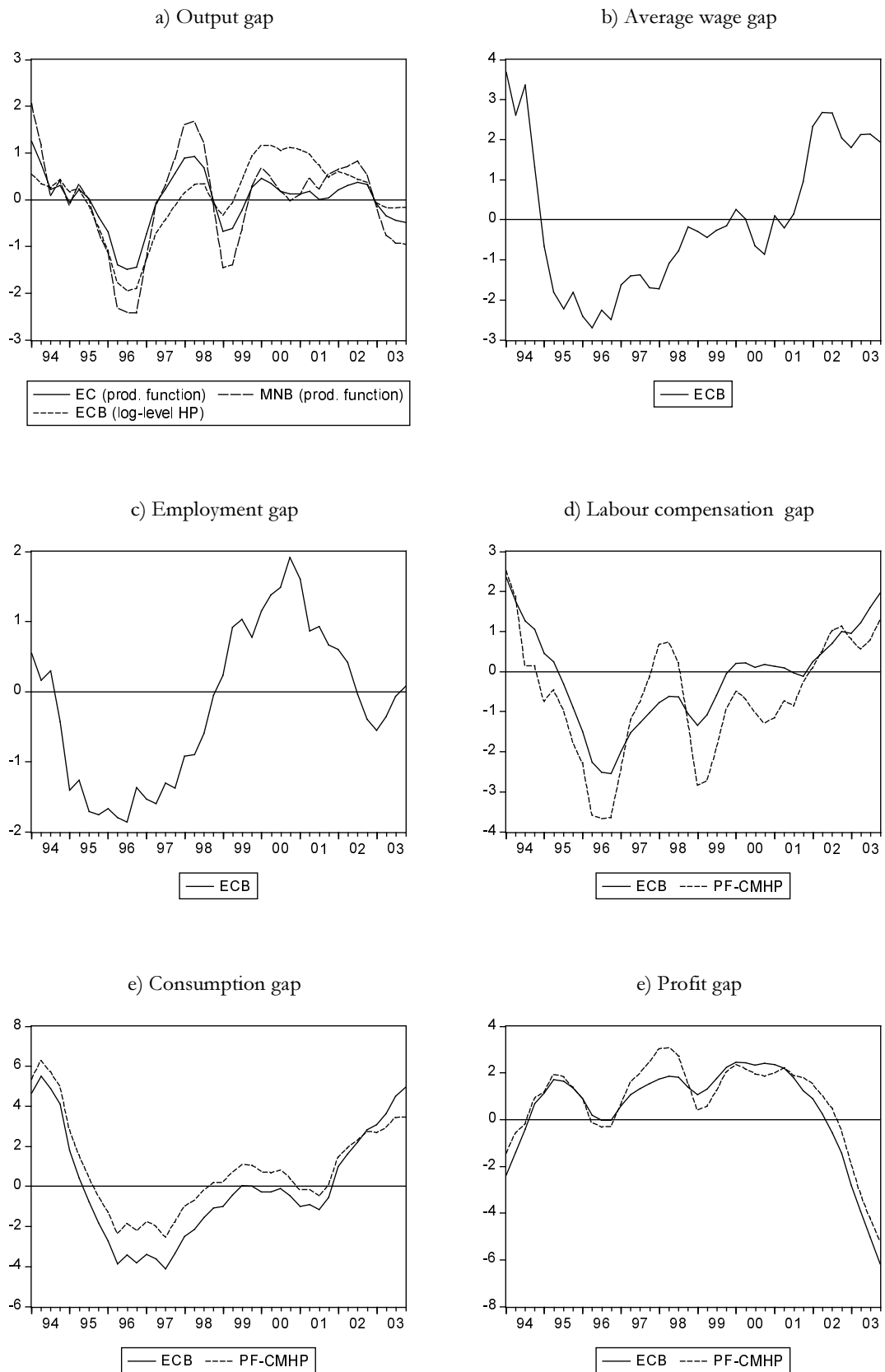
g) Consumption expenditure



h) Profit



**Figure 9 Gaps (%point)**



## **VII. 5. Definitions and data**

### *Variables*

Output and its components are published quarterly basis from 1995 by Hungarian Central Statistical Office. Data of preceding periods are based on Varpalotai (2003).

Unless indicated otherwise, fiscal data are provided on a cash flow basis, relying partly on (monthly) quarterly data from the Treasury, and partly on annual data from the various Budget Execution Laws.

### ***The European Commission approach***

*Direct tax on households:* Personal Income Tax (PIT)

*Direct tax on corporations:* Corporate Income Tax (CIT) including banks, only annual data can be linked to macroeconomic developments because of specific tax rules.

*Indirect taxes:* Value Added Tax (VAT) with estimated refunds by MNB<sup>15</sup>, excise duties, import duties, local business tax (i.e. the value added basis), taxes on mining, gambling and other small taxes.

*Social security contributions:* Contributions paid by employers and employees to Pension Funds, to the Health Care Fund and to the Labour Market Fund. (The latter may be statistically classified as direct tax on households.)

*Unemployment benefits:* Unemployment benefits paid by the Labour Market Fund to those eligible for them for a maximum length of 9 months and social support provided by local governments for those unemployed persons who are not eligible for benefits.

### ***The ECB and MNB approach***

*Direct tax on households* Personal Income Tax (PIT) paid by private employees (estimated from the total PIT on the basis of shares of labour income in the public and private sector).

*Direct tax on corporations:* Corporate Income Tax (CIT) including banks

*Indirect taxes on household consumption:* Value Added Tax (VAT) with an MNB estimation for the underlying pattern of refunds, excluding VAT on house construction, government consumption and investments (official estimations of the MoF) and excise duties.

*Other major indirect taxes:* import duties and local business tax are linked to the value added rather than household consumption.

*Social security contributions:* contributions paid by private employers (we have data on public employers' contribution) and private employees (estimated similarly to the PIT) to the State Pension Fund, to the Health Insurance Fund and to the Labour Market Fund. (The latter may be statistically classified as direct tax on households.)

*Unemployment benefits:* unemployment benefits paid by the Labour Market Fund to those eligible for the for a maximum length of 9 months and social support which provided by local governments for those unemployed persons who are not eligible for benefits.

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<sup>15</sup> Discretionary movements in VAT refunds cannot be filtered out with our current approach of accrual recording, because cash-flow figures are simply adjusted backward by two months. In order to calculating the underlying pattern of VAT refunds MNB corrects cash-flow figures on the basis of own estimates.

*Pensions:* Pensions, disability pensions (under or above the statutory retirement age) and survivors' pensions

***Control variables***

Changes in tax rates, brackets and allowances for direct tax on households: MNB estimation based on detailed data for the distribution of taxable income and actual tax payments prepared by the tax administration.

Changes in tax rate in direct tax on corporations: simple calculation on the basis of statutory rates

Changes in rates and ceilings in social security contributions: MNB estimation based on detailed data for the distribution of taxable income prepared by the tax administration.

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