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Abstract

The paper describes a model for the computation of trend output and the structural budget deficit in Austria. The calculation of trend output is based on a production function approach within a small macroeconomic model of the Austrian economy. A decomposition of public budgets into cyclical and structural components shows responsiveness to business cycle variations, and allows a better assessment of the sustainability of the budget balance. The model will be used in future forecasting rounds and links macroeconomic and budgetary variables of the WIFO-forecast to estimates for trend output and the structural budget deficit. Until now, such decomposition has not been part of the regular WIFO-forecast.

Keywords

Austria, WIFO-forecast, trend output, structual budget balance

1. Introduction[1])

This paper describes a model for the computation of trend output and the structural budget deficit in Austria. A decomposition of public budgets into cyclical and structural components shows their responsiveness to business cycle variations, and allows a better assessment of the sustainability of the budget balance. The model will be used in future forecasting rounds. Until now, such decomposition has not been part of the regular WIFO-forecast. The model therefore needs to draw on those macroeconomic and budgetary variables, which are part of the WIFO-forecast. Model equations are estimated using annual data according to the European System of National Accounts (ESA 95) published by Statistik Austria. These data are currently available for the period 1976 to 2006 and are supplemented by the sector accounts from 1995 onwards. Table A1 in the appendix gives a list of variables used in the model. Figure 1 shows how these variables are fed into the macroeconomic and into the budgetary blocs of the model.

In the case of Austria several attempts to decompose public budgets have been made in the past. For example, the OECD (*Girouard – Andre, 200*5), the European Commission (*Denis, et al.* 2006), and the European Central Bank (*Url*, 2001; *Grossmann – Prammer*, 2005) regularly compute cyclically adjusted budget balances using an indirect approach, i. e. they relate cyclically sensitive budget categories first to specific macroeconomic bases and subsequently link the respective base to the overall output gap. *Jäger* (1990) and *Url* (1997) use structural time series models to estimate a direct response between cyclical budget components and the output gap.

The model presented in this paper also applies the indirect method but we do not relate the macroeconomic base to the general output gap, rather we set up a small scale macroeconomic model that comprises a set of behavioural equations and identities in order to compute the cyclical variation for each of the macroeconomic bases directly. The model can be solved recursively and delivers trend components for each macroeconomic base from which we

[1]) We are grateful to Fritz Breuss for valuable comments and suggestions. The usual disclaimer applies.

derive the cyclical component. Most of the trend and cyclical components of macroeconomic and budgetary variables are modelled in this way; however, we use the Hodrick-Prescott filter for some of the exogenous variables, and to initialize the values of all endogenous trend variables by Hodrick-Prescott-trends.

The macroeconomic bloc of the model is based on a production function of the Cobb-Douglas type, with a factor specific-technical progress. Labor-specific technical progress depends on the share of high skilled workers in the labor force, while capital-specific technical progress is proxied by the ratio of investment in information and communication technology (ICT) to fixed capital formation. Thus, we include an element of an endogenous growth model, in which the accumulations of skills and ICT equipment unfold economies of scale. Both explanatory variables have been identified in the EU-KLEMS project as the driving forces of total factor productivity (*Peneder et al.,* 2007). They can be interpreted as an outcome of household and firm decisions that are not explicitly modelled.

Potential output can be seen either as maximum sustainable output of an economy or as the level of output produced at normal rates of capacity utilization. Here sustainability usually implies a constant inflation rate. Thus defined, an estimate of potential output is usually obtained using filter, or structural methods[2]). We follow the definition of potential output as the output level corresponding to the normal utilization rates of capital and labor. We focus on the normal rather the maximum utilisation of the economy because we want to estimate cyclically adjusted budget deficits, i.e. those deficits, which prevail if there is neither a cyclical upturn nor a downturn. In the following we will refer to this concept of output as the trend output and label the variables accordingly.

Employment is cyclically adjusted using a detrended employment rate as a share of the working-age population. Following *Bock – Schappelwein* (2005) and *Steindl* (2006), we use the share of the unemployed not eligible to regular unemployment benefits as an indicator of

[2]) Different estimation procedures yield different results. For a survey of the most frequently used methods see, for example, *European Central Bank (2000).*

the long-term or structural unemployment. These long-term unemployed are excluded from the trend labor input, while the detrended number of unemployed receiving unemployment benefits is added to the cyclically adjusted employment level. Trend employment is transformed into labor volume using the average number of hours worked. The capital stock corresponds to the actual capital stock and thus is not adjusted for cyclical variation in utilization rates.

The decomposition of budgetary items into cyclical and structural (trend) components uses elasticities estimated using cointegrating equations (*Url*, 2001). These equations relate cyclically dependent budgetary items to their macroeconomic bases. To extract the structural component of a budget item, we use the long-run equation from a cointegrating system, and replace actual values of the macroeconomic variables by their trend values. This approach delivers a set of structural and cyclical components for each cyclically responsive tax and expenditure item. Cyclically responsive items include social security contributions, wage taxes, other direct taxes, indirect taxes, unemployment benefits and pension payments. In addition to the cyclical and structural components, we try to account for past one-off revenue or expenditure measures.

The following section describes the macroeconomic bloc. Section 3 presents the budgetary bloc and motivates our choice of cyclically responsive budget items. In this section we also describe the estimation methodology and the results. The accounting framework is described in Section 4, which also includes results of the decomposition. In the final section we draw some conclusions.

2. Estimation of trend output

This section defines the factor inputs and determinants of the total factor productivity used in the production function, and presents estimates of the production function[3]).

The production function

We estimate trend output using a constant returns to scale Cobb-Douglas production function:

$$YR_t = a_C (a_K KR_t)^{\beta} (a_{LH} LH_t)^{(1-\beta)}, \qquad (2.1)$$

where β is the factor share of capital in total income. The level of output, YR_t is determined by two factor inputs, the capital stock, KR_t, and hours worked, LH_t. The parameters a_k and a_{LH} are, respectively, the capital and labour embodied contributions to total factor productivity, and a_c is the Hicks-neutral component. The above production function implies a unit elasticity of substitution between factors of production.

The capital stock includes buildings, infrastructure, transport equipment, machinery and other equipment, and intangible assets. We use the standard perpetual inventory method described in *Statistik Austria* (2002) and *Peneder et al.* (2007), in which the cumulative flow of fixed capital formation is adjusted for depreciation to calculate the net capital stock. To account for variable capital utilization, we derive a capital utilization measure based on the WIFO Business Cycle and Investment Survey data. The data on capacity utilization are available for the manufacturing sector only. The share of manufacturing in the capital stock is about 10 percent, whereas 60 percent of the capital stock is not assigned to a particular industry. We therefore apply our utilization measure to half of the net capital stock, and assume that the other half is always fully utilized. For the estimation we adjust the capital stock in production function (2.1) for fluctuations in capacity utilization:

$$KR_t = 0.5KR_t^* ((KU_t - \overline{KU}) + 1) + 0.5KR_t^* . \qquad (2.2)$$

[3]) Previous work on the decomposition of output into trend or potential output and cyclical output for Austria includes *Breuss* (1984), *Brandner – Neusser* (1992), *Hahn – Walterskirchen* (1992), *Giorno et al.* (1995), *Hahn – Rünstler* (1996), *Denis et al.* (2006), *Steindl* (2006), and *Breuss et al.* (2007).

Here KR_t^* denotes the total net capital stock resulting from the perpetual inventory method, KU_t is the utilization rate in the manufacturing sector, and $\overline{KU}$ is its mean value between 1976 and 2006. The data for hours worked, LH_t, are taken from the National Accounts and comprise both, employees and self-employed. Data before 1995 are based on backward projections calculated for the EUKLEMS dataset. Taking the logarithm of both sides of equation (2.1) and rewriting the production function in intensive form gives:

$$\log(YR_t / LH_t) = \log a_C + \beta \log a_K + (1-\beta)\log a_{LH} + \beta \log(KR_t / LH_t) . \qquad (2.3)$$

The contributions of total factor productivity a_C , a_K and a_{LH} are not observable, only the difference between measured output and the estimated combination of factor inputs is. This difference is called the Solow residual. In view of the neoclassical growth model total factor productivity (TFP) is regarded as exogenous. An often used measure of technological progress in trend output estimates is the trend of the Solow residual[4]). We do not estimate TFP as a time series, but rather include proxies for factor-specific technological progress. Capital and labour embodied contributions to TFP, a_K and a_{LH}, are proxied by ICT investment as a ratio to fixed capital formation net of ICT investment ($SICT_t$) and the share of high skilled workers in the labour force (SHS_t). These indicators of factor specific productivity have risen in the past by an average rate of, respectively, 0.7 and 4.4 percent per year between 1976 and 2006 (Figure 2).

We estimate the following specification:

$$\log(YR_t / LH_t) = c_0 + c_1 SHS_t + c_2 SICT_t + c_3 \log(KR_t / LH_t) . \qquad (2.4)$$

The estimate of the factor share of capital in total income c_3=β=0.41. This value is slightly below that in the long-run simulation model for the Austrian economy used at WIFO (*Baumgartner et al.*, 2005).

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[4]) See among others *Denis et al*. (2006), *Janger et al.* (2006) and *Steindl* (2006). In a different approach *Horn et al.* (2007) estimate and forecast Germany's TFP as being dependent on the investment ratio, the per-capita expenditure on R&D and the US TFP.

To allow for a comparison to an approach with an exogenous technical progress we also specify the following production function:

$$\log(YR_t / LH_t) = c_0 + c_1 t + c_3 \log(KR_t / LH_t)\,, \tag{2.5}$$

where t is a linear time trend. In this alternative the driving factors of technical progress are left unspecified, which facilitates international comparisons. More details of the estimation results for (2.4) and (2.5) are provided in Table 1.

Normal utilization of factor inputs

In order to estimate trend output YR_t^* we define the normal utilization of factor inputs and substitute them instead of their actual values into production function (2.4). This yields:

$$\log(YR_t^* / LH_t^*) = c_0 + c_1 SHS_t^* + c_2 SICT_t^* + c_3 \log(KR_t^* / LH_t^*)\,. \tag{2.4'}$$

SHS_t^* and $SICT_t^*$ are Hodrick-Prescott filtered trends in factor specific technological progress. The coefficients c_1 through c_3 in equation (2.4') result from unrestricted OLS-estimation of equation (2.4) and can be found in Table 1.

The installed capital stock, KR_t^*, results from a perpetual inventory model with gross fixed investment, IR_t, added each period to the capital stock left over from the previous period:

$$KR_t^* = \sqrt{(1 - DK_t)}IR_t + (1 - DK_t)KR_{t-1}^*\,. \tag{2.6}$$

The depreciation rate is time-variable and applies to installed capital as well as current period investment. We assume KR_t^* is used at the average rate of utilization, implying periods of overutilization and underutilization during the business cycle.

There is no universally accepted definition of utilization adjusted labour input. Both the meaning and the result of a potential output estimate depend on the definition of potential labour supply, and especially on the assumptions regarding the employability of both registered unemployed and the hidden labour reserve (*Steindl*, 2006). We define labour input at normal rates of utilization as the labour force that is available to fill vacancies in the job market if actual output is at its long-term average. In addition to the trend level in employed and self employed persons it also contains part of the registered unemployed.

We obtain the normal level of persons in dependent active employment over the business cycle, LEA_t^*, by multiplying the working age population (aged between 15 and 64), POP_t, with the HP-filtered employment rate RE_t^*:

$$LEA_t^* = RE_t^* POP_t . \tag{2.7}$$

To this cyclically adjusted dependent employment we add the Hodrick-Prescott filtered self employed persons and an estimate of cyclically adjusted unemployment based on administrative classifications of registered unemployment by type of benefits. Following *Bock – Schappelwein* (2005) and *Steindl* (2006) we use the number of unemployed persons eligible to regular unemployment benefits as an indicator for short-term employability. The reasoning behind this choice is that hazard rates for unemployment are declining in the length of unemployment spells (*Boheim*, 2006), and regular unemployment benefits are paid only during the first months of an unemployment spell. The payment of unemployment benefits extends, depending on the duration of past employment, to a maximum of one year[5]).

Following the above idea, we assume that the unemployed, LU_t, comprise two groups: (1) the unemployed receiving unemployment benefits, LUG_t, and (2) the unemployed receiving no unemployment benefits, LUS_t:

$$LU_t = LUG_t + LUS_t . \tag{2.8}$$

Both groups can be decomposed further into cyclical and trend components:

$$LU_t = LUG_t^C + LUG_t^* + LUS_t^C + LUS_t^* , \tag{2.9}$$

[5]) In most studies registered unemployment is broken down into a cyclical and a non-cyclical component using estimates of the non-accelerating inflation rate of unemployment (NAIRU), or the non-accelerating wage inflation rate of unemployment (NAWRU). Both concepts refer to the unemployment rate which is consistent with a stable rate of inflation, or wage inflation, respectively (*Giorno et al.*, 1995; *Denis et al.*, 2006).

where superscripts C and * refer to cyclical and trend components. The cyclical part of the non-recipients, LUS_t^C, is small. We assume that only the recipients, LUG_t, respond to the business cycle, whereas the non-recipients belong to the structural unemployment. This assumption is consistent with the hypothesis of long-term unemployment causing a loss in human capital, so that even in a cyclical upturn it is difficult for this group to find employment (*Pissarides*, 1992). Figure 3 gives an overview of decomposed unemployment. The trend part of the unemployed (non-recipients) amounts to half of the registered unemployed and increased over time[6]).

It follows from decomposition (2.9) that the cyclically adjusted version of total unemployment, LU_t^*, can be approximated as

$$LU_t^* = LUG_t^* + LUS_t^* \approx LU_t - LUG_t^C . \qquad (2.10)$$

We will use equation (2.10) to substitute for trend unemployment in the cointegrating equation of the model. Similarly, we can use this concept to redefine the share of long-term unemployed in total unemployed persons in structural terms as:

$$\frac{\left(LU_t^* - LUG_t^*\right)}{LU_t^*} = \frac{LUS_t^*}{LU_t^*} \approx \frac{\left(LU_t - LUG_t\right)}{\left(LU_t - LUG_t^C\right)}, \qquad (2.11)$$

which holds approximately for small LUS_t^C.

We estimate the labour volume at normal rates of utilization as

$$LH_t^* = (LEA_t^* + LSS_t^* + LUG_t^*)H_t^* , \qquad (2.12)$$

where LSS_t represents self employed persons. Cyclically adjusted average hours worked per person in active employment, H_t^*, are estimated using the following autoregressive relation:

$$H_t^* = c_0 + c_1 trend(1 - DLS92) + c_2 DLS92 + c_3 H_{t-1} . \qquad (2.13)$$

[6]) This phenomenon is referred to as hysteresis (*Blanchard – Summers*, 1986).

The actual level of average hours worked is derived from the ratio of labour volume, LH_t, to the sum of persons in active dependent employment, LEA_t, and the self employed, LSS_t:

$$H_t = \frac{LH_t}{LEA_t + LSS_t}. \tag{2.14}$$

Finally, the level of nominal trend GDP is defined as

$$YN_t^* = YR_t^* PY_t^*, \tag{2.15}$$

where PY_t^* denotes the equilibrium output deflator, which is assumed to grow at 2 percent per year in the future. To back cast nominal trend output we use the trend from a Hodrick-Prescott filter of the output deflator.

Corresponding to the level of trend output, YN_t^*, we estimate the equilibrium real wage per hour, $(WN/PY)_t^*$, using a rule relating the real wage to the marginal product of labor. The marginal product of labor, MPL_t, results from the first order condition using equation (2.4') in a profit maximization problem. By inserting cyclically adjusted values for the explanatory variables in the first order condition we can derive the cyclically adjusted marginal product of labor:

$$\log MPL_t^* = \log(1-\beta) + \log YR_t^* - \log LH_t^*. \tag{2.16}$$

Because the real wage actually deviates from this first order condition we assume a log-linear relation between the cyclically adjusted real hourly wage and the marginal product of labor:

$$\Delta \log\left(\frac{WN}{PY}\right)_t^* = c_0 + c_1 \Delta \log MPL_t^*, \tag{2.17}$$

where Δ denotes the first difference operator $\Delta x_t = x_t - x_{t-1}$. From this equation we can easily infer on the cyclically adjusted nominal wage bill, YWS_t^*, as:

$$YWS_t^* = WN_t^* \left(LEA_t^* H_t^*\right). \tag{2.18}$$

Equations (2.4'), and (2.6) through (2.18) form a system that can be solved recursively for all cyclically adjusted variables, given past actual and forecast values. The central element in the computation of the structural budget is recursive model simulation which brings about trend values for macroeconomic base variables and consequently cyclical deviations from trend.

Trend output and the output gap between 1980 and 2006

We compare our estimate of trend output to actual output growth in Figure 4 and present deviations from the trend component in Figure 5[7]). Over the period 1980-2006, the mean growth rate of actual output was 2.2 percent, while the mean growth rate of factor specific trend output was at 2.4 percent. The model with linear trend gives a mean for the growth rate of trend output of 2.5 percent. Especially at the end of the sample the growth rate of factor specific trend output declines. For the year 2006 it is estimated at just 1.8 percent. Compared to other recent estimates this value is low (*Janger et. al*, 2006; *Steindl*, 2006). The deviation can be explained by the difference resulting from factor specific technical progress versus a trend or a Solow residual concept. Our estimated growth rate of trend output in 2006 from the linear trend model is 2.3 percent, indicating that the assumption about factor specific technological progress creates a reduction in the growth rate by about 0.5 percentage points. Furthermore, we use a more restrictive definition of trend labor input as compared to *Steindl* (2006). First we use cyclically adjusted employment and second, we exclude persons regarded as out of the labor force even if they indicate a readiness to accept a job offer in labor market surveys.

Compared to the standard deviation of trend output the standard deviation of actual output is higher by a factor of four (1.2 against 0.3 percent). In the beginning of the 1990s we identify the most rapid increase in trend output that coincides with a massive wave of immigration due to the break up of the former Yugoslavia. Starting from the peak of 2.7 percent in 1991, trend output growth smoothly declines towards a range slightly below 2 percent per year. This can

[7]) Figure 4 starts in 1980 because we need the first four observations for differencing and as lags (cf. Section 3).

mainly be attributed to a decline in the increase of the total capital stock as of well as capital specific technological progress $SICT_t$ (Figure 2).

Figure 5 shows the output gap measured as percentage deviation from trend, defined as $(YR_t - YR_t^*)/YR_t^* \cdot 100$. In Figure 5 we can clearly identify three business cycle peaks in 1979, 1992, and 2000. The troughs are less clearly seen because during the downturn 1993-1998 the gap is small and during the recession in the mid-1980s the graph indicates a double-dip recession. Our peak dates are very similar to those derived by *Scheiblecker* (2007), which are based on quarterly detrended data. Due to higher data frequency Scheiblecker identifies additional peaks in 1985-1986, 1994-1995 and 2004, which in our case are either part of double-dip recessions or of the more protracted downturn in the mid-1990s. Our troughs, on the other hand, coincide in the years 1987, 1997, and 2003 precisely with Scheiblecker's dating. Again, *Scheiblecker* (2007) detects several additional troughs due to higher data frequency. These appear on our measure as small dents on a more general business cycle development.

3. The estimation of short-run and long-run tax and expenditure elasticities

In this section we identify cyclically dependent budget components and their related macroeconomic bases. We then proceed with an estimation of tax and expenditure elasticities. Elasticities show the ratio between the relative change of a budget component and the relative change of its macroeconomic base, and as such allow us to compute the response of budget components to changes in their macroeconomic base. By combining all tax and expenditure responses to changes in their macroeconomic bases, we obtain indirectly the elasticity of the public budget to the business cycle. This approach has the advantage to account for the fact that different macroeconomic bases respond differently to business cycle variations[8]).

[8]) As an alternative one may consider directly the elasticity of a budget component *D* with respect to nominal output as done by *Jäger* (1990) or *Url* (1997), for example.

The elasticity, ε_{DX}, of a budget component, *D*, with respect to its macroeconomic tax base, *X*, is defined as:

$$\varepsilon_{DX} \equiv \frac{dD/D}{dX/X}. \tag{3.1}$$

By estimating tax and spending elasticities over the period 1979-2006, we have to take into consideration policy changes with substantial impact on the sensitivity of revenues or expenditures to the respective macroeconomic base, e.g. major reforms of tax codes.

In decomposing government revenue we follow the classifications of ESA 95 and apply a narrow concept of cyclical dependence: only budget categories that respond automatically to business cycle variations are decomposed. In particular, on the revenue side of the general government budget we consider wage taxes, other direct taxes except wage taxes, social security contributions, and taxes on production and imports (indirect taxes) to be cyclically responsive. The composition of our cyclically dependent revenue components is summarized in Table 2. We assume 90 percent of government revenue in Austria to depend on the business cycle. On the other hand, there are comparatively few automatic stabilizers on the expenditures side of the Austrian budget. Consequently expenditures are mostly independent from the business cycle, i. e. roughly a quarter of spendings will be regarded as cyclically dependent. In a broader perspective, almost all budgetary components are related to the business cycle, at least to a degree. During economic downswings, for example, the government may decide to raise public investment spending in order to pursue anti-cyclical fiscal policy. We are, however, interested only in budgetary changes related automatically to the business cycle, i. e. without discretionary measures. This approach avoids identifying assumptions necessary to pin down discretionary responses of economic policy to business cycle fluctuations as in *Brandner et al.* (2007).

Unemployment benefits are an obvious automatic expenditure scheme which accounts for about 3 percent of total expenditures. Monetary transfers to long-term unemployed are only weakly related to the cycle and active labor market measures are mostly discretionary.

Previous computations of cyclically adjusted budget deficits by *Url* (2001) and *Grossmann – Prammer* (2005) also considered expenditures on pensions as cyclically dependent because until 2003 the pension adjustment was based on the per capita wage development. This relation exposes another 21.5 percent of expenditures to cyclical variation. Since 2004 the pension adjustment formula is based on changes in the consumer price index but discretionary adjustments to this formula have been implemented since its introduction. We include pension payments into our definition of the cyclical expenditure component because both per-capita wages and the consumer price index respond to the business cycle. The change in the pension adjustment formula will bring about a significant change in the pattern of the cyclical budget component. Whereas per-capita wages vary procyclically, the inflation rate in Austria is anti-cyclical (*Baumgartner*, 2003). We model the break in the legal framework by changing from wage- to inflation-based pension equations.

Wage taxes

Wage taxes, *TW*, consist of the total proceeds of the wage income tax only. The corresponding macroeconomic base is the total sum of wages (*YWS*). We take into account wage income taxes of private and public sector employees. The relevant macroeconomic base thus comprises both the private and the public sector wage bill. This approach is not entirely unproblematic, as public employment is set by the government. Changes in public employment are hence not automatically related to the business cycle. In their computations of elasticities of direct taxes on households, *Grossmann – Prammer* (2005) exclude wage tax proceedings of public sector employees, and consequently take into account only private sector employment as an explanatory variable. Nevertheless, we include public sector wage payments and the corresponding wage tax revenues in our calculations because wage negotiations in the public sector are cyclically dependent at least to a degree. Level shift dummy variables reflect major income tax reforms in 1989, 1994, 2000 and 2005.

In this context, an additional error in the ESA 95 classification affects some taxes related to the payroll (municipal tax (Kommunalsteuer) and employers' contributions to family based monetary transfers (Familienlastenausgleichsfonds)) with total revenues of € 5.6 bn. in 2005.

These two revenue streams are classified as indirect taxes rather than wage taxes. Since those revenue categories are based on proportional rates we do not expect them to significantly reduce the estimated elasticity for wage taxes.

Social security contributions

Cyclical variations of revenues from social security contributions, *SC*, are also related to the development of wages and employment. Additional statutory factors that affect receipts are the maximum assessment ceiling (Höchstbeitragsgrundlage), which limits individual contributions, and the sum of risk specific contributions rates (accident, health, and pension insurance). Discretionary adjustments of the threshold value and the contribution rates are thereby taken into account. Trend revenues from social security contributions shift upward as a result of an increase in the maximum assessment ceiling or the contribution rate.

Other direct taxes

The category 'other direct taxes except wage taxes', *TIWGO*, includes revenues from assessed personal income taxes, the corporate income tax, taxes on interest and dividends, as well as wealth taxes. Revenues from wealth taxes have a comparatively low share in Austria, however. This class of taxes also includes receipts from the motor vehicle tax and the car insurance taxes paid by households[9]).

'Other direct taxes' is a heterogeneous category of tax revenues and proceeds are not always directly related to the business cycle. Most importantly, it is often claimed that interest rates and thus also interest income depends only weakly on the business cycle (e. g. *Grossmann – Prammer*, 2005: 70). Hence, receipts from capital income taxes (KeST) on private households' and firms' earnings might better be subtracted from our base. While this procedure is feasible for a calculation of past structural budget positions, it is currently

[9]) The private firms' share of these taxes falls under the heading of taxes on production and imports.

impractical for forecasts as it requires a prediction of future capital income tax revenues – these are currently not included in the WIFO quarterly forecast. We leave this to future work.

Other direct taxes are probably best related to nominal GDP less total wage income, which is approximately equivalent to gross operating surplus. Since a major fraction of receipts in this category comes from assessed taxes on non-wage income and corporate income, we use values of the macroeconomic base lagged one and two years as explanatory variables. To assess the impact of major tax code revisions we also employ a shift dummy variable for 1994 and a step dummy for 2001 in our estimates.

Taxes on production and imports

According to ESA 95, taxes on production and imports include, inter alia, the value added tax (VAT), mineral oil tax, tobacco tax, insurance tax, energy duties and the motor vehicle tax paid by firms. By far the single most important revenue source in this class of taxes is the VAT, which accounted for 54 percent of total taxes on production and imports in 2005. Private consumption expenditures are usually used as the macroeconomic base for indirect taxes but several components of private consumption are exempt from taxes or are taxed at reduced rates. Shifts in the structure of consumption will thus affect the elasticity. Furthermore, the mineral oil tax, energy duties and tobacco tax are, in contrast to VAT, not (exclusively) related to value-added but are based primarily on the quantities consumed. About 20 percent of receipts of taxes on production and imports come from quantity-related taxes.

Additionally, public consumption net of public sector wage payments is usually subject to indirect taxes. If we include indirect tax revenues from public consumption, we consequently would have to include public consumption expenditure into the relevant macroeconomic base. Doing so enables us to side-step an open discussion on whether or not public consumption spending is cyclically dependent.

Private investment and exports are also not free from indirect taxes, as energy duties, and the exporting firms' share of motor vehicle taxes fall under the heading of taxes on production and imports. Finally, as mentioned above, the ESA 95 definition of taxes on production and imports also includes wage-related taxes like the municipal tax and employers' family fund contributions (FLAF).

Summing up, it seems appropriate to link revenues from taxes on production and imports directly to nominal GDP instead of the narrower measure of private consumption expenditure. Alternative regressions not shown in the following suggest that especially during recent years private consumption is only weakly associated with indirect tax revenues, and that the relationship is becoming more and more unstable. While private consumption may be a good proxy for the tax base of VAT and other goods taxes, it is too narrow a macroeconomic base to estimate revenue elasticities for the broader ESA 95 category of taxes on production and imports. In our regressions we also include level shift dummy variables for the VAT reform in 1984 and changes in tax codes due to Austria's accession to the EU in 1995.

Transfers to the unemployed

On the expenditure side of the budget we take into consideration monetary transfers to the unemployed, including related social security contributions. The typical macroeconomic base is the number of unemployed and the per capita wage from the previous year, as unemployment benefits depend on earnings in the previous year. We take into account that transfers to the long-term unemployed (receivers of welfare aid (Notstandshilfe)) are smaller than regular payments to the short-term unemployed. Although transfers of social security contributions from the unemployment insurance to the social security system are deficit-neutral, we include these transfer payments into our expenditure measures because the estimated elasticity will be affected by these discretionary transactions. We account for those transfers by considering the share of social security contributions in total unemployment expenditures as an explanatory variable.

Expenditures on pensions

We consider expenditures on pensions as cyclically dependent. Until 2003 the pension adjustment formula related the increase of pensions paid out by the social security system to the change in per-capita wages in the previous year. Consequently, the increase in the average pension was directly linked to the wage development. In 1993 the adjustment formula has been changed such that the development in net per-capita wages formed the base for pension adjustments, i. e. after 1993 increasing social security contributions were subtracted before computing rates of change. With the pension reforms of the years 2003-2005 a link to the inflation rate of the Consumer Price Index has been established although discretionary adjustments to this basic formula have been inacted in every year. Given this inexact nature of the adjustment formula, we will base the cyclical adjustment between 1979 and 2003 on the wage base and afterwards on CPI-inflation. In the simulation model both formulas will be included into one single equation with time varying coefficients. Instead of the CPI we use the GDP-deflator to ensure consistency with ESA 95. The coefficient vector resulting from the per-capita wage equation gives the parameters for the first period and is set to zero after 2003. The parameters of the GDP-deflator equation will be zero for the period until 2003 and feature the respective estimates from 2004 onwards.

Table 3 gives an overview of cyclically variable budget items, their respective macroeconomic bases, and of conditional variables capturing structural changes not mirrored in the development of the macroeconomic base.

Estimation method

In order to estimate elasticities of budget components we follow *Url* (2001) and *Grossmann – Prammer* (2005) by employing a two-step error correction technique, using data for the period 1976 to 2006. First, we estimate the long-run relationship between (log) levels of a certain budget component, $D_{i,t}$, and the (log) level of its respective macroeconomic base $X_{i,t}$. We also include several control variables Z_t for discretionary changes of tax and expenditure policies and other events (e. g. Austria's accession to the EU in 1995). Note that $Z_{i,t}$ may not be identical for all tax and expenditure components. Lagged residuals from the long-run equation of the cointegrating model are then included as an additional explanatory variable (lagged co-integration term) into the short-run regressions. Denote the first difference operator as $\Delta D_{i,t}=D_{i,t}-D_{i,t-1}$, then the short-run equation of the cointegrated variables is

$$\Delta \log\left(D_{i,t}\right)=c_0+c_1\Delta Z_{i,t}+c_2\Delta \log\left(X_{i,t}\right)+c_3 D_{iR,t-1}+\eta_{i,t}\,, \qquad (3.2)$$

where c_2 is an estimate of the short-run elasticity of a budget component with respect to its macroeconomic base, and c_3 is the adjustment parameter in the cointegration model, which determines the speed at which equilibrium errors $D_{iR,t-1}$ diminish. For an error correction to occur this parameter must be negative. A higher absolute value of c_3 indicates faster adjustment towards a long-run equilibrium. The equilibrium error arises from the residual of the long-run linear relationship[10]):

$$\log\left(D_{i,t}\right)=c_0+c_1 Z_{i,t}+c_2\log\left(X_{i,t}\right)+D_{iR,t}\,. \qquad (3.3)$$

With respect to tax variables the long-run elasticity c_2 in equation (3.3) should not exceed unity, because in a steady state tax receipts cannot exceed their respective macroeconomic tax base. We therefore restrict $c_2=1$ in our estimates in general, and conduct F-tests to check for the validity of this restriction.

Table 4 summarizes the regression results for six short-run budget elasticities. Each column refers to one of the cyclically adjusted budget items. The first set of variables are the constant and either step or level shift dummies. The dummy variables indicate changes in the legal code and coincide with dates of major tax reforms. We include dummy variables if they are significant in either the short- or the long-run equation. Interestingly, the regression equations for social security contributions and transfers to the unemployment do not require dummy variables to correct for legal interventions. Instead corrective factors, such as the social security contribution rate and the maximum assessment limit provide enough information to reflect discretionary institutional changes.

[10]) As noted above, revenues from other direct taxes except wage taxes are not related to the contemporary macroeconomic base but to one-year and two years lagged values instead.

The short-run elasticities vary between 0.79 for indirect taxes and 1.31 for wage taxes (Table 4). Overall, the regression fit is good and residual-based tests indicate only minor problems with outliers in the wage tax equation and heteroscedasticity in the social security equation. Due to a low number of observations, the regression for pension payments after the reform of the pension adjustment formula serves only to fix the constant after 2003.

We restrict our estimate for the elasticity of social security contributions with respect to the macroeconomic base to unity because we directly manipulate hourly wages by multiplying it with the social security contribution rate. We also restrict the response of pension outlays to the change in per-capita wage to unity. Both restrictions are not rejected by the data. As expected from our discussion of taxes on production and imports, indirect taxes respond less than proportional to variations in nominal output. Finally, the elasticities of unemployment transfers are slightly below unity in both the number of unemployed and the per capita wage of the previous year. The adjustment speed to disequilibrium in the tax revenues is surprisingly fast. All error correction terms enter significantly the short-run equation. Estimates for the adjustment parameter for taxes, are around one half, i. e. half of the equilibrium error is corrected within the next period implying a half life of one year. Essentially, this implies a full correction after four years. In the case of unemployment benefits we include two lags of the error term to reduce autocorrelation in the residual of the short-run equation. Alternatively, we could use the lagged change in unemployment benefits. The net effect of both lagged adjustment coefficients is negative and thus allows for an appropriate error correction mechanism.

The long-run equations are presented in Table 5. We impose more structure on the estimation of long-run elasticities because in most cases values different from unity are implausible in a steady state equilibrium. Thus long-run elasticities of wage and other direct taxes as well as social security contributions are restricted to unity. All of these restrictions cannot be rejected at the 5 percent level of significance. For both direct tax variables this holds even at the 1 percent level. Although the long-run elasticity of product and import taxes is just below unity, we do not restrict this coefficient; similarly, we leave coefficients in the unemployment benefits regression unadjusted.

Our choice of cyclical budget components is largely determined by outputs from the WIFO quarterly forecast and fails to coincide exactly with definitions used by the European Commission, the European Central Bank, or the OECD. For this reason and because of different sample periods we cannot provide fully comparable estimates for short-run elasticities. Nevertheless, we summarize recent estimates for short-run elasticities of Austrian budget components with respect to their macroeconomic base in Table 6. The estimates by the ECB and the OeNB are based on a cointegrating approach similar to ours. The OECD estimates are based on tax codes and data on the income distribution. Previous estimates by WIFO (*Url*, 1997) and by *Jäger* (1990) are direct estimates of elasticities with respect to the output gap and result from fitting structural time series models.

Direct taxes on households consist mainly of wage taxes and our concept of other direct taxes corresponds very closely to direct taxes on firms. Our estimate for the elasticity of household taxes is within the range of previous estimates. We do not find a higher short-run elasticity of the wage tax with respect to wages as a result of the higher tax progression introduced by recent tax reforms. On the other hand, the short-run elasticity of other direct taxes is above previously estimated values. This may be a consequence of higher tax progression for self-employed or our loose definition of gross operating surplus as the difference between output and the total wage bill (YN_t-YWS_t). The smaller coefficient for indirect taxes reflects the break down in the relation between indirect taxes and private consumption mentioned above. The elasticity with respect to nominal output is considerably below unity. The elasticities for social security contributions, unemployment benefits and pension payments closely match previous estimates.

4. Decomposition of budget components

We decompose each budget item, D_i, into a structural, D_i^*, a cyclical, D_i^C, a discretionary, D_i^D, and an irregular component, D_i^I, as follows:

$$D_{i,t} = D_{i,t}^* + D_{i,t}^C + D_{i,t}^D + D_{i,t}^I . \tag{4.1}$$

The identification of structural and cyclical budget components is based on the combination of trend components of macroeconomic base variables with information from the cointegrating equations for each budget item. The discretionary component is given exogenously by narrowly defined one-off revenues and expenditures and the irregular component will result as a residual from equation (4.1).

We define the structural budget component as the level of revenues or expenditures that would occur if the output gap of the economy were zero, i. e. if there is neither a positive nor a negative deviation from trend output. The structural components can be computed by using the long-run revenue and expenditure equations for each of the budget items evaluated at the respective macroeconomic base derived from solving the system (2.4'), and (2.6)-(2.18).

For example the revenue from indirect taxes follows an error correction model relating indirect taxes to nominal output, YN_t, the error correction term, $TINDG_{R,t}$, and deterministic variables related to a major tax reform and Austria's accession to the EU:

$$\begin{aligned}\Delta\log(TINDG_t) = c_{tindg} + b_{tindg,1}\Delta DLS84_t + b_{tindg,2}\Delta DLS95_t + \varepsilon_{tindg}\Delta\log(YN_t) + \\ \alpha_{tindg} TINDG_{R,t-1} + \eta_{tindg,t}\end{aligned} . \tag{4.2}$$

The error correction term follows from the inverted long-run equation in levels:

$$TINDG_{R,t} = \log(TINDG_t) - \left[d_{tindg} + g_{tindg,1}DLS84_t + g_{tindg,2}DLS95_t + \beta_{tindg}\log(YN_t)\right]. \tag{4.3}$$

This pair of regression equations shows the average response of indirect taxes to changes in the tax base, YN_t, i.e. the coefficients show the average response of the budget component over all stages of the business cycle. We use the long-run equation for the computation of the structural budget component by substituting trend output at current prices, YN_t^*, for the actual output, YN_t, in (4.3) and solve for the conditional expectation of $TINDG_t^*$:

$$TINDG_t^* = E[\log(TINDG_t)] = d_{tindg} + g_{tindg,1} DLS84_t + g_{tindg,2} DLS95_t + \beta_{tindg} \log(YN_t^*). \quad (4.4)$$

In several cases we restrict the long-run elasticity as β_i=1. Consequently, during periods without corrective interventions the structural component of indirect taxes may deviate from actual data even if the output gap is zero. Such deviations arise from anticipated discretionary action.

In the following, we will rely on equations similar to (4.4) for the computation of the structural component of the other budget items. The only exception is expenditures on unemployment benefits, which are conceptually inversely related to their macroeconomic bases. We compute the cyclical component of each budget category indirectly by combining the percentage gap between the actual and the trend level of the macroeconomic base with the short-run tax elasticity:

$$D_{i,t}^C = \varepsilon_{iX} \left(\left(X_{i,t} - X_{i,t}^* \right) \big/ X_{i,t}^* \right) D_{i,t}^* . \quad (4.5)$$

The gap and the short-run response are evaluated at the level of the respective structural budget component. Overall, most of the revenue side of the public sector is subject to cyclical variation, whereas on the expenditure side only unemployment benefits and pension outlays vary with the business cycle.

We introduce only one discretionary component on the revenue side, GR_t^D, reflecting one-off government receipts from the auction of UMTS-licences in 2000. Revenues from UMTS-licenses are defined as negative expenditures according to ESA 95. We deviate from this classification because these receipts are booked as revenues in the regular public budget. A small part of revenues is not related to the business cycle, we call this part other tax revenues, TO_t, and subsume it into the structural component of revenues.

The discretionary component on the expenditure side, GE_t^D, is confined to expenses on military aircraft. This is in contrast to the classification of the European Commission, which treats expenses on military aircraft as regular outlays.

Given the exogeneity of the discretionary component, the irregular component follows directly from definition (4.1):

$$D_{i,t}^I = D_{i,t} - D_{i,t}^* - D_{i,t}^C - D_{i,t}^D . \tag{4.6}$$

We compute the structural component of government expenditures, GE_t^*, by first subtracting total expenditures on unemployment and pensions from total government expenditures, GE_t, and then adding their structural components again:

$$GE_t^* = GE_t - UG_t - SEP_t + UG_t^* + SEP_t^* . \tag{4.7}$$

After computing structural components for each of the four cyclically dependent revenue items, we add the category other tax revenues, TO_t, to arrive at an estimate of the structural revenue component, GR_t^*:

$$GR_t^* = TW_t^* + TIWGO_t^* + SC_t^* + TINDG_t^* + TO_t . \tag{4.8}$$

The structural deficit, GB_t^*, results from the difference between structural revenues and expenditures:

$$GB_t^* = GR_t^* - GE_t^* . \tag{4.9}$$

Similarly, the cyclical component of the budget deficit, GB_t^C, is the sum over all individual cyclical revenue components minus cyclical expenditure components:

$$GB_t^C = \left(TW_t^C + TIWGO_t^C + SC_t^C + TINDG_t^C\right) - \left(UG_t^C + SEP_t^C\right). \tag{4.10}$$

The discretionary part of the deficit, GB_t^D, results from combining exogenous one-off revenues or expenditures:

$$GB_t^D = GR_t^D - GE_t^D . \tag{4.11}$$

Similarly, we can construct the irregular part of the deficit, GB_t^I, as:

$$GB_t^I = \left(D_{tw,t}^I + D_{tiwgo,t}^I + D_{sc,t}^I + D_{tindg,t}^I\right) - \left(D_{ug,t}^I + D_{sep,t}^I\right). \quad (4.12)$$

The structural deficit between 1976 and 2006

The computation of the structural budget deficit over the period 1979-2006 relies on the long-run cointegrating regressions for each cyclically responsive budget item. Most of the macroeconomic bases result from the simulation of the macroeconomic core of the model, but several trend variables are derived from applying the Hodrick-Prescott filter to exogenous variables. The exogenous HP-trends are the indicators of factor specific technological progress, i. e. the smooth components of investments in communication and telecom equipment, $SICT_t^*$, and education, SHS_t^*. Furthermore, we use the Hodrick-Prescott filter to decompose the number of persons receiving unemployment benefits, LUG_t, and the GDP deflator, PY_t, into trend, LUG_t^* and PY_t^*, and cyclical components, LUG_t^C and PY_t^C. To estimate the normal utilization of employment, we use the Hodrick-Prescott filter to find the trend component of the employment rate, RE_t^* and the self employed persons, LSS_t^*.

In the following, we discuss the decomposition of government revenues, expenditures, and the budget balance into structural, cyclical, and discretionary components. Figure 6 shows the cyclical component of government revenues in relation to total revenues. The strongest cyclical position, with +2¼. percent of government revenues, occurred during 1992-1996. This period coincides with the pronounced upswing of the economy at the beginning of the 1990s. Several lags in the short-run tax equations cause a lengthening of the budget cycle as compared to the business cycle. A similar, less pronounced positive cycle occurred at the beginning of the 1980s. The smallest upturn around the year 2000 left almost no visible trace in the cyclical revenue component. The years 1987 and 2004 mark the troughs in terms of the cyclical budget component. Interestingly, periods of depressed government revenues do not seem especially long compared to recessions. Business cycle upturns tend to be stronger than recessions in Austria. This pattern is also reflected in a distinctly asymmetric cyclical revenue component. The biggest positive deviation is measured at 2.3 percent of total revenues in 1992, whereas the most negative deviation was 1.8 percent in 1988. Discretionary revenues from UMTS licenses made up for 0.8 percent of total revenues in 2000.

Figure 7 shows the cyclical component of government expenditures. Figure 7 illustrates that by and large expenditures seem to follow a delayed procyclical pattern. This is the outcome of the comparatively high elasticity of pension outlays with respect to lagged per-capita wages which themselves lag behind the business cycle. These lags create considerable cyclical variation in pension payments. Accordingly, between -0.6 and +1.2 percent of government expenditures are due to business cycle fluctuations with the biggest cyclical outlay occurring in 1994, two years after the business cycle peak in 1992. Recently, the cyclical variation in government expenditures declined considerably, with the downturn in 2003 causing almost no cyclical response. This is a direct consequence of the shift towards flexible CPI-based pension adjustments after 2003.

Subtracting cyclical government expenditures from cyclical revenues yields the cyclical budget deficit. We relate this measure to output at current prices, as a reasonable benchmark to compare public deficits over time. Figure 8 shows the actual budget deficit along with the cyclical component. The cyclical deficit component varies in the range between -1 and +1 percent of GDP and is small in comparison to the actual deficit. Peaks and troughs roughly coincide with the cyclical development of government revenues.

The structural budget deficit is not directly the mirror image of the cyclical deficit because of sizable discretionary and irregular components. Nevertheless, Figure 9 shows that the structural deficit in Austria is close to the actual deficit during most of the sample period. Until the beginning of the 1990s the structural deficit fluctuated around -3 percent of GDP. In the first half of the 1990s a sharp deterioration of the structural deficit occurred with a lower turning point of -5.7 percent happening in the boom year 1993. After 1995, fiscal consolidation set in, mounting in a balanced structural budget in 2001. Since then the structural budget surplus went back into the negative and reached -1.8 percent of GDP in 2006.

Figure 10 compares our results with European Commission figures of structural deficits over the period 1976 to 2006, based on potential output estimation and on Hodrick-Prescott-filtered series, respectively. Overall, our estimates show a similar pattern and closely match EU estimates after 1995. Before 1995, however, our estimates mostly show higher structural budget deficits.

5. Summary and Conclusions

The computation of trend output is based on a production function approach within a small macroeconomic model of the Austrian economy. We estimate trend components of macroeconomic variables by solving this model recursively for the past. For a few variables we rely on Hodrick-Prescott filtered trend components. Future forecasts of trend output and the decomposition of public budgets into cyclical and structural components will be based on the regular WIFO-forecasts of macroeconomic variables. This approach will allow us to extent the period for a recursive simulation towards the end of the forecast horizon of the regular WIFO forecast.

Our estimate of trend output reacts strongly to changes in factor specific technical progress. In the current model a stagnation of either human capital or ICT investment will cause a surprisingly large reduction in the growth rate of trend output. Given that those shares eventually converge to their steady state values, total factor productivity would eventually stagnate in our model.

Some of our variables such as revenues or revenue bases are only indicators of the respective variable in the theoretical sense and therefore may include components that do not vary with the business cycle. For example, wages in the public sector are included in total wages but show only minor cyclical variation. The definition of other direct taxes, on the other hand, certainly includes non-cyclical revenues components such as taxes on interest income. Broadening the definition of endogenous or exogenous variables reduces the size of the estimated elasticities. Nevertheless, in terms of budget components, this will, on average, compensate for the broader definition of the variable and leave the estimate of the cyclical and structural component unaffected.

The model-based approach suggested here cannot link the cyclical deficit directly to output growth rates, moreover, we can only indirectly infer on the responsiveness towards fluctuations in the overall output gap. Given that the standard deviation of the nominal output gap is 1.74 percent of trend nominal output and the standard deviation of the cyclical deficit in relation to trend nominal output is 0.56 percent, we conclude from the ratio between these standard deviations that the elasticity of the cyclical deficit with respect to variation in nominal output is 0.25. This value is similar to the coefficient of a regression of the cyclical deficit ratio on the nominal output gap (0.24). Both values are low compared to the elasticity of 0.38 presented by the OeNB (*Grossmann – Prammer*, 2005), the value of 0.47 published by the European Commission (*European Commission*, 2005), and the OECD-figure of 0.44 (*Girouard – Andre*, 2005). Part of the difference between the current WIFO estimate and the European Commission and the OECD values is due to the inclusion of pro-cyclical pension expenditures into our cyclical budget balance. The smaller difference with respect to the OeNB-value is also explained by the same approach towards pension expenditures. The change in the pension adjustment formula will increase the responsiveness of the Austrian budget balance to the business cycle from 2004 onwards. Another explanation for the limited cyclical response is our explicit modelling of lags in macroeconomic base variables. Several budget categories are linked to lagged macroeconomic base variables. Moreover, macroeconomic base variables themselves show lags with respect to the overall business cycle. These features blur the relation between the output gap and the cyclical budget balance. In an international comparison, our estimate of the sensitivity of the Austrian budget balance with respect to the business cycle ranges among the lowest.

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Table 1: Macroeconomic bloc

	Dependent variables:							
	Log of real output per hours worked (log YR_t/LH_t) Equation (2.4)		Log of real output per hours worked (log YR_t/LH_t) Equation (2.5)		Cyclically adj. average working hours per person (H*) Equation (2.10)		Log of cyclically adjusted real hourly wage log(w/p)* Equation (2.14)	
Exogenous variables								
Constant	1.030	**	1.658	***	0.619	***	-0.002	
SHS	3.150	**						
SICT	1.772	**						
Log capital-labor relationship	0.411	**	0.307	***				
trend(t)			0.014	***				
trend(1-DLS92)[1)]					-0.002	*		
DLS92					-0.030	***		
Average working hours per person in active employment (H) lagged one period					0.131			
Log marginal product of labor							0.766	***
Adjusted R-squared	0.99		0.99		0.64		0.30	
Durbin-Watson Statistic	1.04		0.77		1.94		2.21	

Note: * indicates significance at 10 percent level; ** indicates significance at 5 percent level; *** indicates significance at 1 percent level. - 1) DLS92 was set adjusting for a structural break in 1995. Starting 1995 LH_t was taken from national accounts; data before 1995 are from the EUKLEMS data set. Because of better model characteristics we model the break in 1992, otherwise a coefficient of almost unity for the average working hours per person in active employment, results in a lagged - rather a filtered relationship between the two time series.

Table 2: Composition of the public budget according to European System of National Accounts, 2006

	Mio. €	In percent of GDP
Total revenues	**123,339**	**47.8**
Social Security contributions (SC)[1])	41,161	16.0
Taxes on production and imports (TINDG)[1])	36,022	14.0
Direct taxes	33,764	13.1
Wage taxes (TW) [1])	*19,100*	*7.4*
Other direct taxes (TWIGO) [1])	*14,664*	*5.7*
Other Revenues (TO)	12,391	4.8
Total expenditure	**127,187**	**49.3**
Unemployment related expenditures	4,420	1.7
Unemployment benefits (UG) [1] *)*	*3,481*	*1.3*
Expenditures on active labor market measures	*939*	*0.4*
Pension payments (SEP)[1])	27,358	10.6
Other primary expenditures	122,767	47.6
Deficit or Surplus	**-3,848**	**-1.5**
GDP at current prices	**257,897**	**100.0**

Source: Bundesministerium für Finanzen, Statistics Austria. - 1) Cyclically responsive budget items.

Table 3: Budget components responding to the business cycle and their main macroeconomic base

Budget Component	Macroeconomic Base(s)	Other intervening factors
Social security contributions (*SC*)	Nominal wage income (YWS)	Contribution rates, fixed assessment ceilings
Taxes on production and imports (TINDG)	Nominal GDP (*YN*)	Tax reforms, EU accession 1995
Wage taxes (*TW*)	Nominal wage income (YWS)	Tax reforms
Other direct taxes (TIWGO)	Nominal GDP - nominal wage income (*YN-YWS)*, lagged one year	Tax reforms
Unemployment benefits (UG)	Number of unemployed (LU), nominal hourly wage (WN)	Share of long-term unemployed (entitled to welfare aid), share of social security contributions on total unemployment benefits
Pension payments (SEP)	Nominal per-capita wage (YWS/LEA) or GDP-deflator (PY)	Reform of pension adjustment formula

Table 4: Coefficients of dynamic regression equations:

$$\Delta \log(D_t) = c_0 + c_1 \Delta Z_t + c_2 \Delta \log(X_t) + c_3 D_{R,t-1} + \eta_t$$

	Dependent variables: Changes in Log of …						
	Social security contribution per unit of labor volume (SC/(LEA·H))	Direct taxes except wage tax (TIWGO)	Indirect taxes (TINDG)	Wage taxes (TW)	Unemployment benefits (UG)	Pension benefits1) (SEP)	Pension benefits2) (SEP)
Exogenous variables							
Constant	0.00	-0.01	0.01	0.02	0.01	0.02 ***	0.02 ***
Changes in							
DLS84			0.05 ***				
DLS89				-0.24 ***			
DLS93						-0.04 ***	
DLS94		0.22 ***		-0.06 ***			
DLS95			-0.09 ***				
DLS00				-0.06 ***			
DLS05				-0.07 ***			
D01		0.22 ***					
Log hourly wage							
Log per capita wage lagged one period						1.00	
Log hourly wage times social security contribution rate	1.00						
Log hourly wage over HBGL	-0.13						
Log output net of wages lagged one period		0.47					
Log output net of wages lagged two periods		0.78 ***					
Log output			0.79 ***				
Log wages				1.31 ***			
Log wages lagged one period					0.84 ***		
Log unemployed					0.93 ***		
Log GDP deflator lagged one period							1.00
Cointegration term lagged one period	-0.14	-0.60 ***	-0.70 ***	-0.67 ***	0.26 ***	0.01	
Cointegration term lagged two periods					-0.56 ***		
Sample	1978-2006	1979-2006	1977-2006	1977-2006	1979-2006	1978-2003	2000-2006
Adjusted R^2	0.92	0.72	0.86	0.82	0.95	0.73	-0.79
Durbin Watson Statistic	1.72	1.69	1.70	1.74	2.35	2.28	1.09
2nd order Q-Statistic	0.09	1.56	3.45	0.60	2.39	1.75 *	0.51 *
Jarque-Bera test	4.14	1.27	1.12	19.08 ***	1.01	1.48	1.31
White test on heteroscedasticity	8.09 ***	0.82	1.75	0.37	0.94	0.99	34.21
Wald-X^2-Test for coefficient restriction	0.08	-	-	-	-	0.07	6.96 **

Note: * indicates significance at 10 percent level; ** indicates significance at 5 percent level; *** indicates significance at 1 percent level. - 1) Until 2003 pension adjustment was tied to previous period's change in average wages. - 2) From 2005 onwards pension adjustment is tied to changes in the consumer price index.

Table 5: Coefficients of cointegrating regressions:

$$\log(D_t) = c_0 + c_1 Z_t + c_2 \log(X_t) + D_{R,t}$$

	Dependent variables: Changes in Log of …						
	Social security contribution per unit of labor volume (SC/(LEA·H))	Direct taxes except wage tax (TIWGO)	Indirect taxes (TINDG)	Wage taxes (TW)	Unemployment benefits (UG)	Pension benefits[1]) (SEP)	Pension benefits[2]) (SEP)
Exogenous variables							
Constant	-1.43 ***	-2.27 ***	-1.21 ***	0.01	0.39 *	5.49 ***	10.05 ***
DLS84			0.03 **				
DLS89				-0.05			
DLS93						-0.06 ***	
DLS94		-0.04		0.00			
DLS95			-0.04 **				
DLS00				0.00			
DLS05				-0.02 **			
D01		0.24 ***					
Log hourly wage							
Log per capita wage lagged one period						1.38 ***	
Log hourly wage times social security contribution rate	1.00						
Log hourly wage over HBGL	-0.28 ***						
Log output net of wages lagged one period		1.01					
Log output net of wages lagged two periods		-0.01					
Log output			0.79 ***				
Log wages times trend of average wage tax rate				1.00			
Log wages lagged one period					1.30 ***		
Log unemployed					0.78 ***		
Log GDP deflator lagged one period							1.97 ***
Sample	1976-2006	1978-2006	1976-2006	1976-2006	1977-2006	1978-2003	2000-2006
Adjusted R^2	1.00	0.99	1.00	0.99	1.00	1.00	1.00
Durbin Watson Statistic	0.67	1.26	1.49	1.78	0.59	0.80	3.27
2nd order Q-Statistic	17.04 ***	4.14	4.15	2.67	10.92 ***	12.04 ***	5.36 *
Jarque-Bera test	1.13	1.80	13.41 ***	2.93	1.68	1.04	0.44
White test on heteroscedasticity	1.95	1.46	2.51 *	1.63	2.79 **	1.85	0.55
Wald-X^2-Test for coefficient restriction	0.62	0.03	-	8.83 ***	-	-	-

Note: * indicates significance at 10 percent level; ** indicates significance at 5 percent level; *** indicates significance at 1 percent level. - 1) Until 2003 pension adjustment was tied to previous period's change in average wages. - 2) From 2005 onwards pension adjustment is tied to changes in the consumer price index.

Table 6: Comparison of short-run elasticities for Austrian cyclical budget components with previous studies

		direct approaches[1]			indirect approaches[2]		
Budget item	W.r.t. macroeconomic base	WIFO (old)	Jäger	OECD	ECB	OeNB	WIFO
Social security contributions	Average wages	-	0.46	1.00	0.90	0.99	1.00
	Employment	-	-		1.00	1.00	1.00
Indirect taxes	Private consumption	0.90	0.51	1.00	0.93	0.97	0.79 [7]
Direct taxes on households	Average wages	1.98	1.98	2.20	1.34	1.30 [3]	1.31 [5]
	Employment	-	-		1.00	1.00	-
Direct taxes on companies	Gross operating surplus lagged one period	3.78	2.22	1.00	1.11 [4]	0.90 [4]	1.25 [4][6]
Unemployment-related expenditure	Number of unemployed	-	-	1.00	0.91	0.88	0.93
	Average wages lagged one period	-	-	-	-	-	0.84
Pension transfers	Average wages	-0.47	-0.55	-	1.00	0.98	1.00
Estimation period		1955-1995	1965-1989	1999-2003	1955-1998	1976-2004	1976-2006

S: WIFO (old): Url (1997), Jäger (1990), ECB: Url (2001), OECD: Giruard - Andre (2005), OeNB: Grossmann - Prammer (2005), WIFO. - 1) Elasticities with respect to output gap. - 2) Elasticities with respect to gap in respective macroeconomic base variable. - 3) Sum of coefficients on contemporaneous and one period lagged observations. - 4) Sum of coefficients on first and second lag. - 5) Wage taxes with respect to total wage bill as macroeconomic base. - 6) Direct Taxes except wage tax as budget item. - 7) GDP at current prices as macroeconomic base.

Figure 1: Structure of the model for trend output and the decomposition of the public budget

Exogenous variables from WIFO-forecast

Macroeconomic variables
SHS, SICT, SHS*, SICT*
DK, IR, (KU)
RE, RE*, POP1564
LEA, LH, LSS, LU, LUG, LUG*, H
WN, YN, YR, YWS
PY, PY*

Budgetary variables
HBGL, RTW*, SCR
(SC, TINDG, TIWG, TW, UG, SEP)
GR, GE, GR^D, GE^D

Simulation model

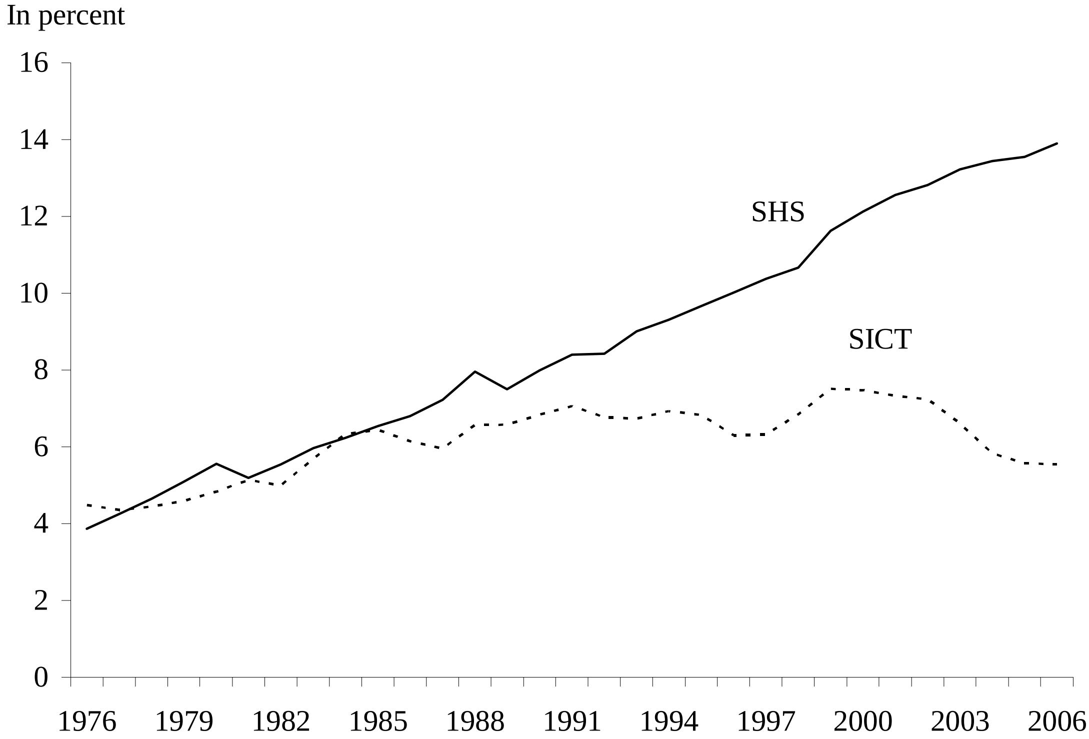
Macroeconomic model
YR*, H*, LEA*, LH*, LU*,
MPL*, WN*, YN*, YWS*

Budgetary model
(SC, TINDG, TIWGO, TO, TW, UG, SEP)
SC*, TINDG*, TIWGO*, TO, TW*, UG*, SEP*
SC^C, $TINDG^C$, $TIWGO^C$, TO, TW^C, UG^C, SEP^C
SC^I, $TINDG^I$, TWIGOI, TO, TW^I, UG^I, SEP^I

Accounting model
GR*, GE*, GB*
GR^C, GE^C, GB^C
GR^I, GE^I, GB^I

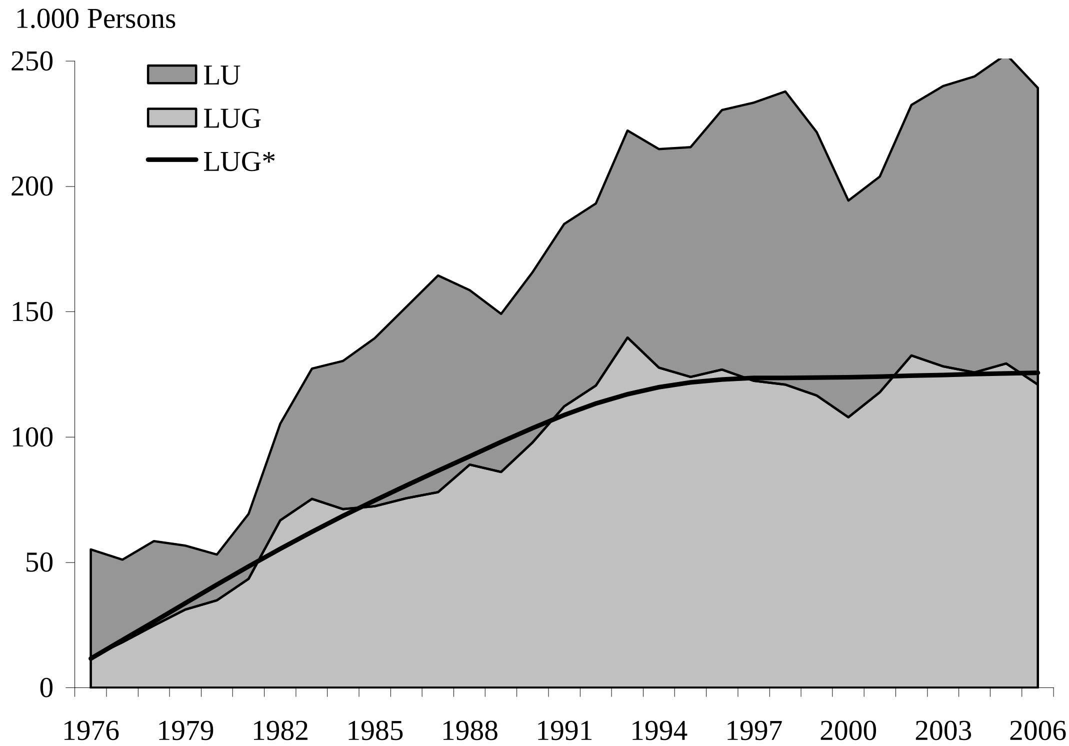
Note: Variables in brackets are needed for estimation purposes only. The model output for variables in brackets may be used as forecast value.

Figure 2: Indicators of factor specific technical progress for the computation of trend output



Source: EUKLEMS, Statisitk Austria, Eigene Berechnungen. - Note: SHS represents the share of high skilled labor in the total labor force. - SICT represents the ratio of ICT-investment to total fixed investment net of ICT.

Figure 3: Decompositon of unemployment



Source: AMS, WIFO. - Note: LU represents registered unemployed. LUG represents registered unemployed eligible for regular unemployment benefits, LUG* represents its HP-filtered trend.

Figure 4: A comparison of actual and trend output growth

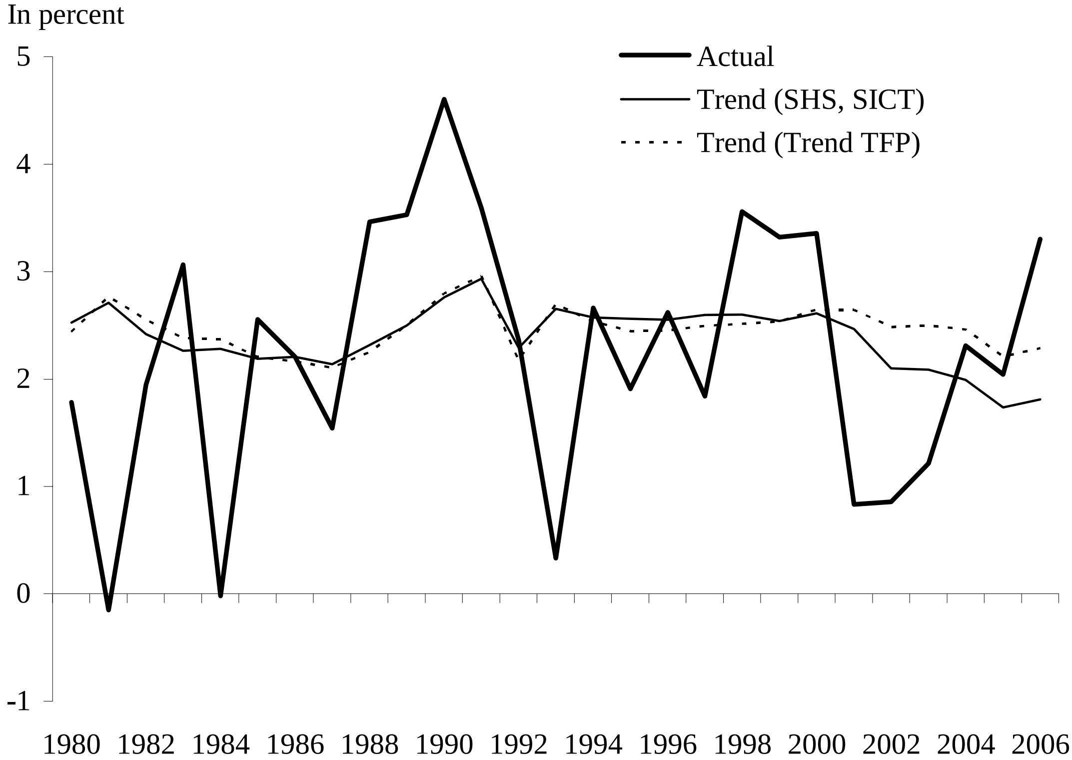


Figure 5: The output gap of the Austrian economy
In percent of trend output

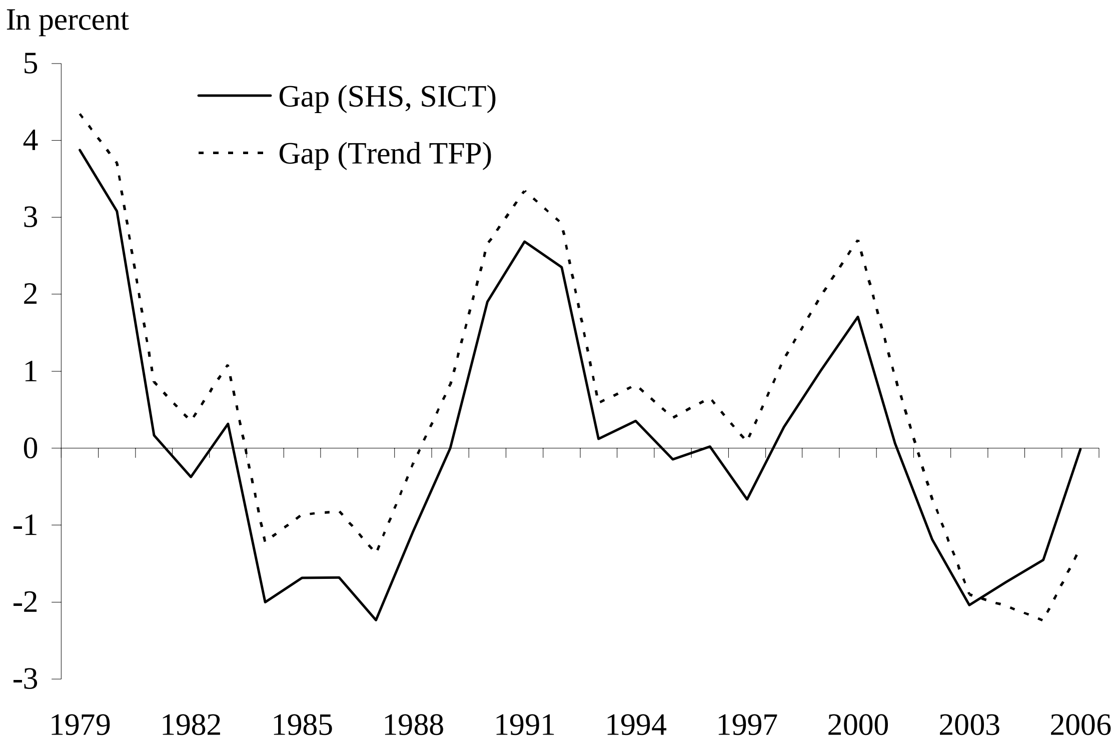
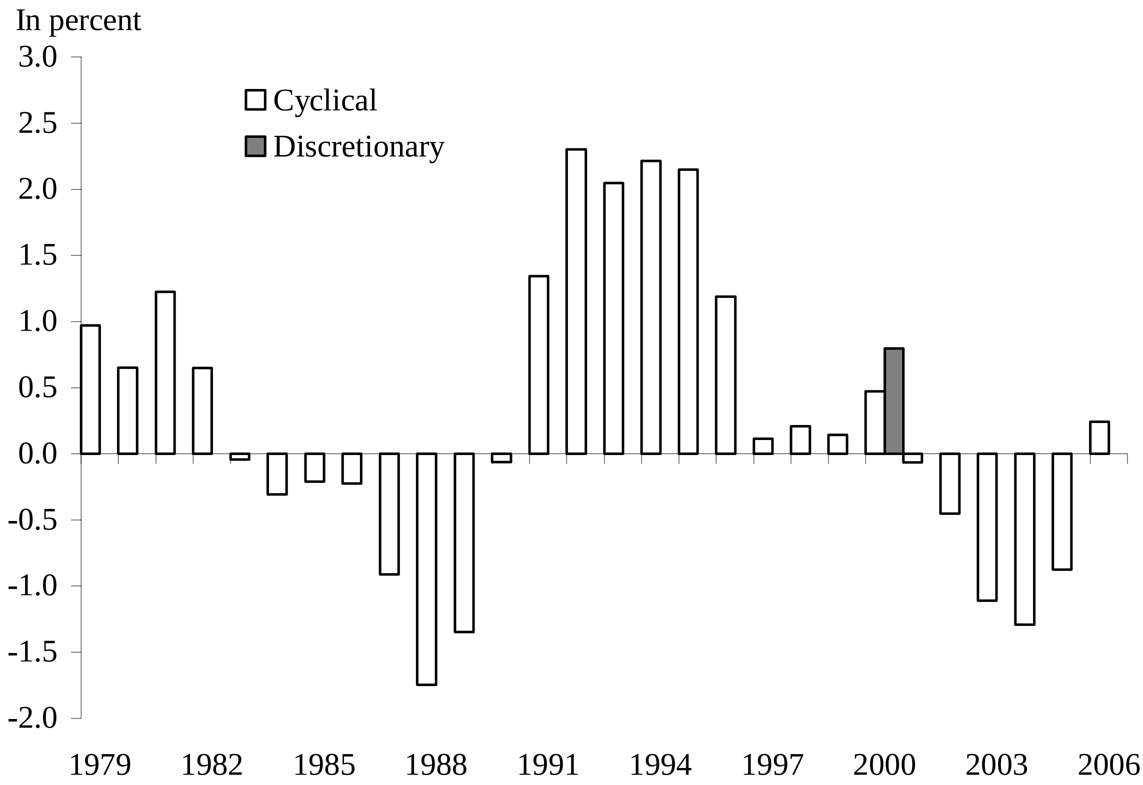


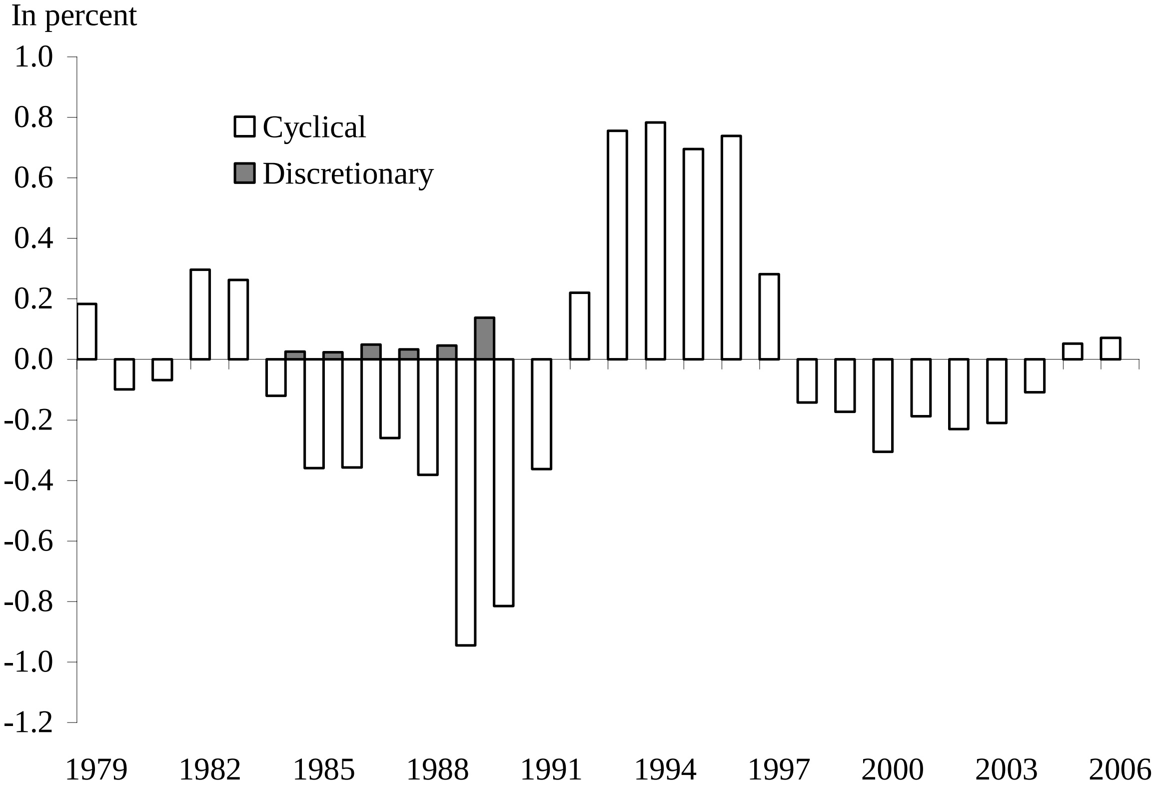
Figure 6: Cyclical and discretionary components of government revenues
In percent of total revenues



Note: Discretionary component corresponds to revenues from UMTS-licenses. Contrary to this classification UMTS-licence fees are accounted as negative expenditures within ESA 95.

Figure 7: Cyclical and discretionary components of public expenditures

In percent of total expenditures



Note: Discretionary component corresponds to purchases of military aircraft.

Figure 8: Actual and cyclical components of public sector deficit
In percent of GDP

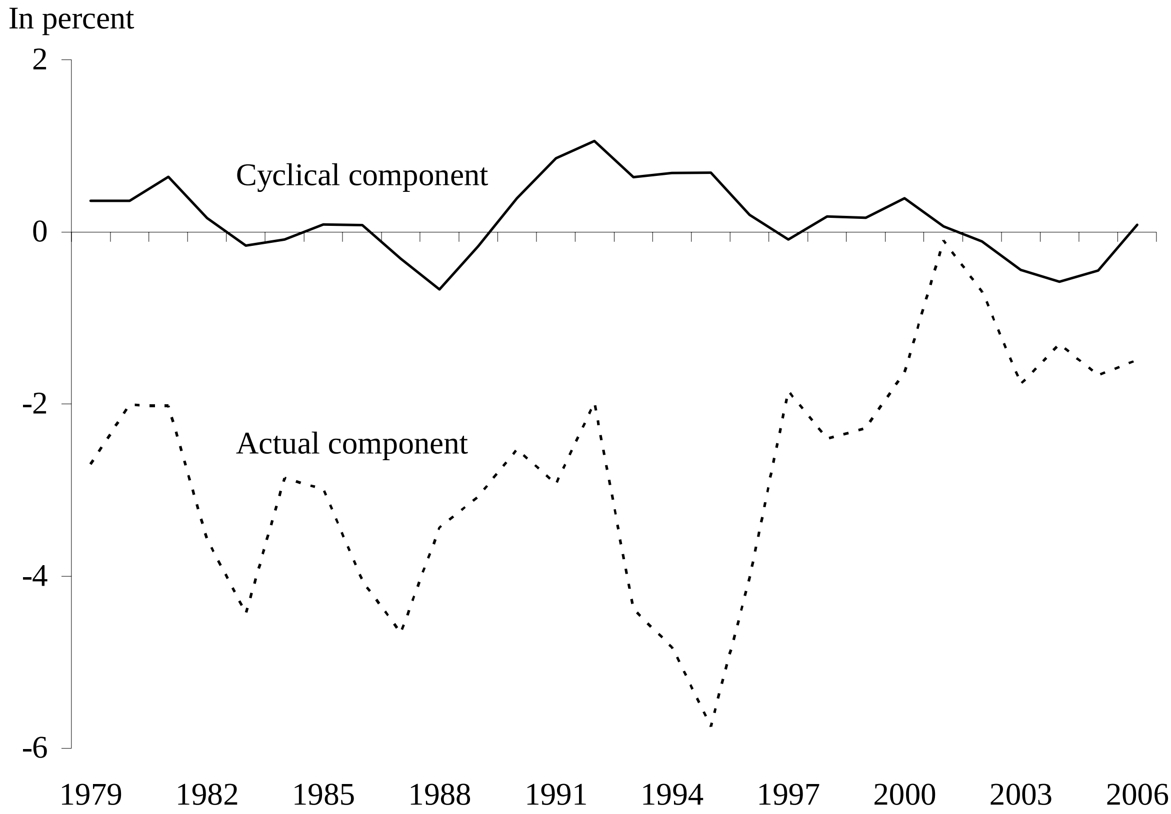


Figure 9: Actual and structural components of public sector deficit
In percent of GDP

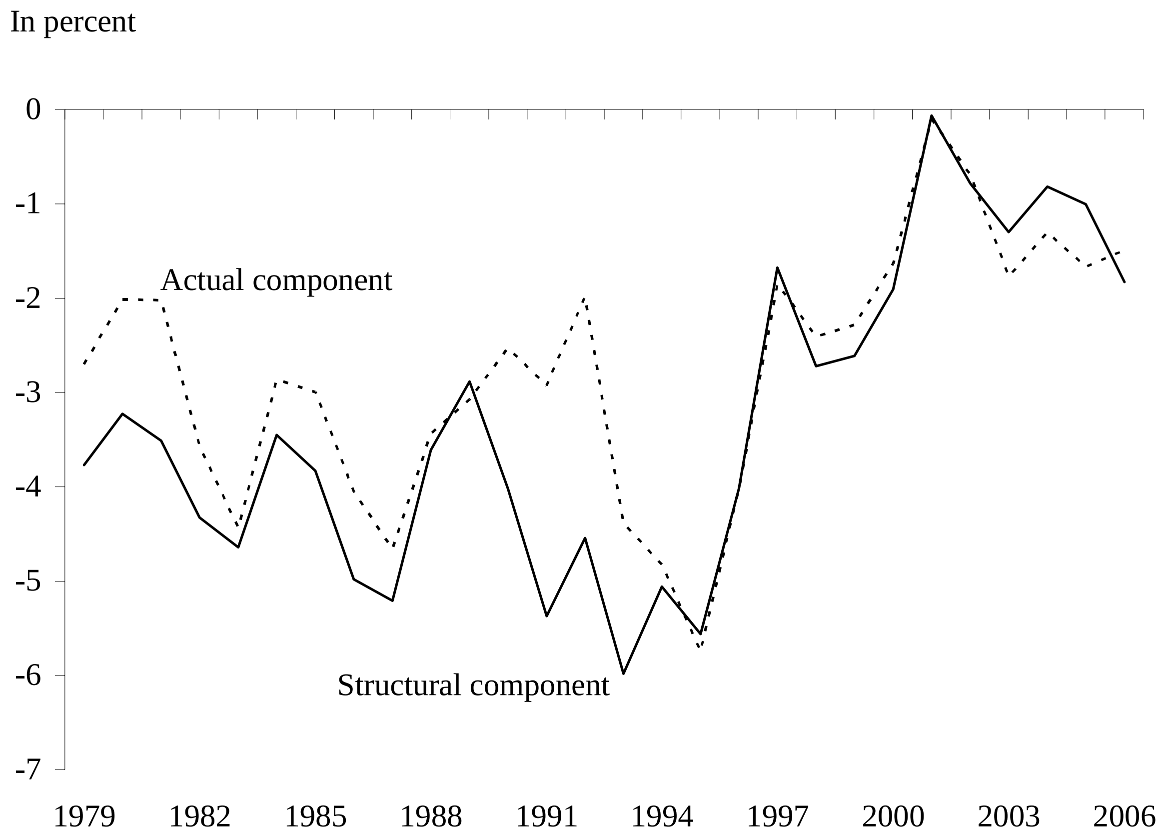


Figure 10: Structural deficits: EU versus WIFO
In percent of GDP

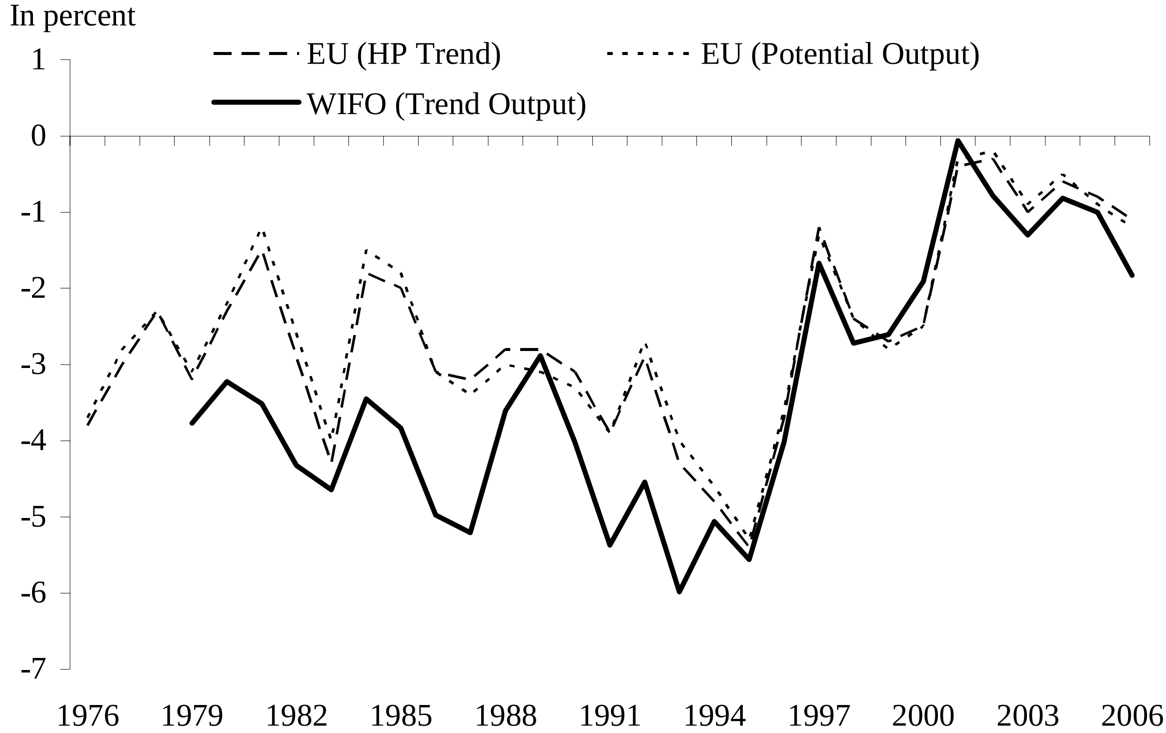


Table A1: List of variables

DK	Rate of capital depreciation	Abschreibungssatz für Kapitalgüter
GB	General government financial balance, as a percentage of GDP	Finanzierungssaldo Staat, in Prozent des Bruttoinlandsproduktes
GE	Government expenditures, at current prices	Staatsausgaben, laufende Preise
GR	Government revenues, at current prices	Staatseinnahmen, laufende Preise
H	Working hours per person in active employment, in 1000 h	Arbeitsstunden je aktiv Erwerbstätigen, in 1.000 Stunden
HBGL	Upper threshold pension and accident insurance contributions, at current prices	Höchstbeitragsgrundlage der Pensions- und Unfallversicherung
IR	Gross fixed capital formation	Bruttoanlageinvestitionen
KR	Physical capital stock, adjusted for variable capital utilisation, at constant prices	Nettokapitalstock, um varialbe Auslastung angepaßt, real
KU	Rate of capacity utilization, WIFO business survey	Auslastungsgrad des Kapitals, WIFO KT
LEA	Persons in dependent active employment, in million persons	Unselbständig aktiv Beschäftigte, Mio. Personen
LH	Labour volume, active employment, in mill. hours	Arbeitsvolumen der aktiv Erwerbstätigen, in Mill. Stunden
LSS	Self employed, in million persons	Selbständig Beschäftigte, Mio. Personen
LU	Registered unemployed, in 1.000 persons	Registrierte Arbeitslose, in 1.000 Pers.
LUG	Registered unemployed eligible for regular unemployment benefits, in 1.000 persons	Registrierte Arbeitslose mit Bezug von Arbeitslosenunterstützung, in 1.000 Pers.
MPL	Marginal product of labour	Grenzprodukt des Faktors Arbeit
POP1564	Population of working age (15 to 64 years), in million persons	Bevölkerung im erwerbsfähigen Alter (15 bis 64 Jahre), in Mill. Personen
PY	Deflator, GDP	Deflator, Bruttoinlandsprodukt
RE	Employment rate, in percent	Beschäftigungsquote der aktiv Erwerbstätigen, in Prozent
RSC	Contribution rate, social and unemployment insurance (employees)	Beitragssatz zur Sozial- und Arbeitslosenversicherung (Angestellte)
RTW	Wage taxes, average tax rate (divided by 100)	Durchschnittlicher Lohnsteuersatz (dividiert durch 100)
SC	Social contributions, at current prices	Sozialbeiträge, laufende Preise
SHS	Share of high skilled labour in labour force	Anteil der High-Skilled Labour am Arbeitsangebot
SICT	Ratio of ICT-investment to total gross fixed investment net of ICT at current prices	Verhältnis der ICT-Investitionen zu den Bruttoanlageinvestitionen ohne ICT zu laufenden Preisen
TINDG	Taxes on production and imports, receivable, general government, at current prices	Empfangene Produktions- u. Importabgaben, Staat, laufende Preise
TIWGO	Current taxes on income and wealth except wage taxes, at current prices	Einkommen und Vermögensteuern ohne Lohnsteuer, laufende Preise
TO	Other government revenues, at current prices	Restliche Staatseinnahmen, laufende Preise
TW	Wage taxes, at current prices	Lohnsteuer inkl. AK u. Land AK Umlage, laufende Preise
UG	Transfer expenditures, unemployment insurance, at current prices	Leistungsausgaben d. Arbeitslosenversicherung
WN	Hourly wages, at current prices	Stundenlöhne, laufende Preise
YN	Gross domestic product, at current prices	Bruttoinlandsprodukt, laufende Preise
YR	Gross domestic product, at constant prices	Bruttoinlandsprodukt, real
YWS	Wages and salaries, at current prices	Bruttolöhne u.-gehälter insgesamt, laufende Preise

Note: National accounts and budget data are in mill. Euros

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