OECD Economic Studies No. 24, 1995/I

POTENTIAL OUTPUT, OUTPUT GAPS AND STRUCTURAL BUDGET BALANCES

Claude Giorno, Pete Richardson, Deborah Roseveare and Paul van den Noord

TABLE OF CONTENTS

Introduction 168
Estimating Potential Output and Output Gaps 169
Detrending actual output 170
Estimating potential output 172
Comparison of results. 179
Estimating Structural Budget Balances 191
Estimation methods 191
Elasticity assumptions 192
Structural budget balances: results 194
Annex: Determination of Income-tax and Social Security Contributions Elasticities. 203
Bibliography 209

The authors would like to acknowledge the useful comments from colleagues in the Economics Department and in particular, Jørgen Elmeskov, Michael Feiner, Richard Herd and Willi Leibfritz. Debbie Bloch, Marie-Christine Bonnefous, Jan Davies-Montel, Jackie Gardel, Tara Gleeson, Josiane Gutierrez and Anick Lotrous provided invaluable technical assistance.

INTRODUCTION

Measuring productive potential and the position of output in relation to potential (*i.e.* the output gap) are important elements in the OECD Secretariat's economic assessments, providing a number of key insights into macroeconomic performance. For the short term, measures of the size and persistence of existing output gaps provide a useful guide to the balance between supply and demand influences and hence the assessment of inflation pressures.[1] For the medium term, measures of productive potential – those which embody information about trend developments in the stock of capital, the labour force and factor productivity – provide a useful guide to the aggregate supply capabilities of the economy and hence the assessment of the sustainable noninflationary growth paths of output and employment.

Indicators of the output cycle also provide a means of "looking-through" short-term transitory influences, to identify any build-up in underlying imbalances or structural positions in the macroeconomy. This is particularly important for fiscal analysis, where developments in underlying structural budget deficits are a cause for concern in many Member countries, and estimates of the output gap can be used to identify and isolate the impact of cyclical factors on the budget. Thus, short-term improvements in budget positions due to a pick-up in economic activity may be reversed as activity slows down and should therefore not be seen as an underlying improvement in public finances. If underlying structural deficits imply a trend towards unsustainable public debt positions, then this indicates the need for effort and specific policy actions to redress the situation. Changes in the structural deficit also provide some indication of the degree of stimulus or restraint that the government provides to demand over and above that given by the automatic stabilisers[2] and, *inter alia*, a measure of the degree of fiscal consolidation.

Given the importance attached to measures of potential and cyclical positions, the OECD Secretariat has recently completed a major review of the estimation methods used in its conjunctural assessments and the construction of its indicators of structural budget balances. In the past, two different forms of analysis have typically been used.

First, in its modelling work and country-specific conjunctural assessments, emphasis had been given to measures of potential output which are structural and depend on a production function framework. These draw on information concerning developments in the capital stock, working population, participation rates, structural unemployment and factor productivity. Such measures may be qualified, sometimes heavily, by the judgement of country specialists. In such a framework,

specific weight can also be given to the perceived limits to sustainable non-inflationary growth associated with the labour market, making use of information about both actual and underlying natural rates of unemployment (more precisely, the so-called non-accelerating wage rate of unemployment, or NAWRU).

Second, the OECD Secretariat's fiscal indicators have previously been based on measures of trend output and cycle derived by the application of time-series regression methods to actual developments in real GDP.[3] Though parsimonious in the use of information, such methods are relatively mechanical, have some difficulty in dealing with underlying structural changes and often require *ad hoc* judgements about the current cycle to keep results within reasonable bounds. It is of particular concern that the weaknesses of time-series methods are often most apparent for the period of greatest interest to policy-makers – the present and the near future – and that they take no account of the structural limits to growth or associated inflation pressures.

For these reasons, and because it would seem preferable to use a single indicator in the assessment of inflation developments and structural budget balances, the OECD Secretariat has revised its estimation methods to provide a single measure of potential output. Specifically, the chosen measure applied across the range of OECD countries is one which represents the level of real GDP, and associated rates of growth, which would be sustainable over the medium term at a stable rate of inflation. Nonetheless, it is clear from this work and the wide range of analytic and survey-based indicators which are available, that significant margins of error are involved in their estimation and use. Reliance therefore cannot wholly be placed on a single measure of potential or trend output and related indicators must therefore be treated with due caution

The basis of this assessment is described in the rest of this paper. Three estimation methods – two forms of GDP smoothing and the preferred production function-based method – are reviewed in the first part, which includes an evaluation of the respective strengths and weaknesses and comparative results for the corresponding trend and output gap estimates. Corresponding estimates of structural budget deficits and associated tax and expenditure elasticity assumptions are described in the second part, which also provides an assessment of the implications *for* fiscal developments in OECD countries.

ESTIMATING POTENTIAL OUTPUT AND OUTPUT GAPS

A variety of methods can be used to calculate trend or potential output and a corresponding output gap, but this paper concentrates on comparisons of the split time-trend method previously used by the OECD Secretariat to calculate structural budget balances with two alternatives.[4] The first alternative involves smoothing GDP using a Hodrick-Prescott (HP) filter. As with the split time-trend method, the HP filter is a statistical technique for determining a trend measure of GDP, by calculating a weighted moving average over time, and is therefore subject to similar limitations. The second approach is to estimate potential output using a production function relationship and estimates of the factor inputs available to the economy.

This requires more information and assumptions about economic inter-relationships, but is less mechanical and more directly relevant to macroeconomic assessment.

Detrerding actual output

Split time-trend method

Previous OECD Secretariat work on fiscal indicators has used a split time-trend method to calculate trend output growth during each cycle, with the cycle defined as the period between peaks in economic growth. The peaks themselves are defined as occurring where the positive output gap is largest, using the following formula:

$$\ln Y_t = \alpha_0 + \sum_{i=1}^{n} \alpha_i T_i + e, \qquad [1]$$

where: Y_t = real GDP
α_i = trend growth coefficient
T_i = segment of the broken time trend
e = error term

Such a specification allows estimated trend growth to change between cycles, but not within each cycle. While in theory this method is straightforward, in practice determining where the peaks in the cycle occur is more complicated, using the residuals obtained by regressing GDP on a time trend in an iterative process. Hence the trend determines the peaks, but the peaks also determine the trend.

The main advantages of this method are that once the peaks have been identified and the cycle thus defined, output gaps are simple to calculate and are symmetric over each complete cycle. But there are two major shortcomings. Firstly, the method imposes a deterministic trend during the course of each cycle and permits structural breaks to occur only at the peak of the cycle. This is inconsistent with a wide range of theoretical and empirical analyses which suggest that trend output is stochastic rather than deterministic (for example, see Nelson and Plosser, 1982). Furthermore, to the extent that discrete structural breaks occur, they often represent permanent shocks and there is no reason to expect them to be correlated with any particular point in the cycle.

Secondly, for the current cycle, the timing and the size of the next peak is likely to be unknown, so the method outlined above can only be applied by making assumptions about the position and timing of the next peak. In practice, current trend output has to be projected judgementally, taking into account on an *ad hoc* basis available information about labour force growth, capital formation and productivity. Such a judgmental projection also affects past values of the trend. back to the end of the last complete cycle. Thus, for the period of most interest to policy makers – the present and the near future – the split time-trend method relies on *ad hoc* judgements about the evolution of trend output. These may be closer in spirit

to a potential output approach, but without the rigour of the procedure described below.

Smoothing GDP using a Hodrick-Prescott filter

The GDP smoothing approach using an HP filter fits a trend through all the observations of real GDP, regardless of any structural breaks that might have occurred, by making the regression coefficients themselves vary over time. This is done by finding a trend output estimate that simultaneously minimises a weighted average of the gap between output and trend output, at any point in time, and the rate of change in trend output at that point in time. More precisely, the trend Y^* for $t = 1, 2 \ldots .T$ is estimated to minimise

$$\sum_{t=1}^{T} (\ln Y_t - \ln Y_t^*)^2 + \lambda \sum_{t=2}^{T-1} \{(\ln Y_{t+1}^* - \ln Y_t^*) - (\ln Y_t^* - \ln Y_{t-1}^*)\}^2 \qquad [2]$$

where his the weighting factor that controls how smooth the resulting trend line is. A low value of λ will produce a trend that follows actual output more closely, whereas a high value of λ reduces sensitivity of the trend to short-term fluctuations in actual output and, in the limit, the trend converges to the mean growth rate for the whole estimation period.

In common with split time-trend methods, this approach requires only actual observations of GDP, but a major criticism is the arbitrary choice of λ which determines the variance of the trend output estimate.[5] From a statistical point of view, λ must be arbitrarily chosen, because any non-stationary series (integrated of order 1) can be decomposed into an infinite number of non-stationary trend and stationary cycle combinations and no satisfactory statistical criterion has been developed to identify which trend/cycle decompositions might be better than others. For many applications in the literature, λ is set to the specific value originally chosen by Hodrick and Prescott ($\lambda = 1\,600$). This seems to have become a *de* facto "industry standard': although this choice was based on a prior view about the ratio of the variance of the cycle to the variance of the trend (see Hodrick and Prescott 1980) for the specific data series being adjusted.[7]

Since the choice of λ remains a key judgement, there are three possible decision criteria. The first would be to follow Hodrick and Prescott's approach and choose a constant ratio of the variances of trend output and actual output. Applied to many countries, this approach would generate a different λ value for each country and would mean that countries whose actual output fluctuates more would also show greater fluctuation in trend. A second approach would be to impose a uniform degree of smoothness and the same variance in trend output For each country. A difficulty with both these criteria is that they ignore the possibility that some countries respond with greater flexibility to economic shocks than others. which would affect how closely trend output would follow actual output. A third approach is to choose a value of λ that generates a pattern of cycles which is broadly consistent with prior views about past cycles in each country. Such a criteria

is judgemental and is able to incorporate (limited) information about the past, but it is also less transparent than the other criteria.8

As with the split time-trend method, the HP filter method also has an end-point problem. In part this reflects the fitting of a trend line symmetrically through the data. If the beginning and the end of the data set do not reflect similar points in the cycle, then the trend will be pulled upwards or downwards towards the path of actual output for the first few and the last few observations. For example, for those countries which are slower to emerge from a recent recession, an HP filter will tend to underestimate trend output growth for the current period. This problem can be reduced by using projections which go beyond the short-term to the end of the current cycle. For example, in the current study, GDP projections from the OECD medium-term reference scenario[9] have been used to extend the period of estimation until 2000 to give more stability to estimates for the current and short-term projections period. In effect this amounts to giving specific weight to judgements about potential and output gaps embodied in those projections, with HP filter estimates tending towards the projected path of potential, provided the output gap is closed by the end of the extended sample period.

A further possible weakness of the method is the treatment of structural breaks, which are typically smoothed over by the HP filter, moderating a break when it occurs, and spreading its effect forwards and backwards over several years, depending on the value of λ. This may be appropriate if a break occurs gradually over time but is problematic in the case of large discrete changes in output levels due to sudden demand or supply shocks.

Estimating potential output

From the point of view of macroeconomic analysis, the most important limitation of GDP smoothing methods is that they are mechanistic and bring to bear no additional information about the structural constraints and limitations on production due to the availability of factors of production or other endogenous economic influences. Thus, trend output growth projected by time-series methods may be inconsistent – too high or too low – with what is known or is being assumed about the growth in capital stock, labour supply or factor productivity, or may not be sustainable without creating severe inflationary pressures. The "potential output" approach outlined below attempts to overcome these shortcomings in a structural framework whilst adjusting for the limiting influence of demand pressure on employment and inflation. It does so in a way in which judgement can also be exercised on some of the key elements.

The framework used for estimating potential output is broadly that adopted in the OECD Secretariat's supply modelling work, as previously described by Torres and Martin (1989) and Torres *et al.* (1989). In its simplest form, a two-factor Cobb-Douglas production function for the business sector is estimated for each country, for given sample average labour shares. The estimated residuals from these equations are then smoothed to give corresponding measures of trend total factor productivity. Potential output for the business sector is then calculated by combin-

ing this measure of trend factor productivity with the actual capital stock and estimates of "potential" employment, using the same estimated production function. The chosen measure of "potential" employment is one defined as the level of labour resources that might be employed without resulting in additional inflation. In effect, this amounts to adjusting actual labour input for the gap between actual unemployment and the estimated NAWRU level.

More specifically, the estimation method follows the following steps. First the estimated business-sector production function is assumed to be of the form:

$$\ln Y = \alpha \ln N + (1 - \alpha)\ln K + \ln E \qquad [3]$$

i.e. $y = a n + (1 - \alpha)k + e$

where: Y = business-sector value added
N = business-sector labour input
K = business-sector capital stock
E = total factor productivity
a = average labour share parameter
lower-case letters indicate natural logarithms.

For a given value of the labour share, a, the e series is calculated and then smoothed using a Hodrick-Prescott filter to provide a measure of trend factor productivity, e*. Next, the trend factor productivity series, e*, is substituted back into the production function along with actual capital stock, k, and "potential" employment, n*, to provide a measure of the log of business-sector potential, y*, as:

$$y^* = \alpha n^* + (1 - a)k + e^* \qquad [4]$$

where the level of potential employment in the business sector, N*, is calculated as:

$$N^* = LFS\ (1 - NAWRU) - EG \qquad [5]$$

where: LFS = smoothed labour force (the product of the working age population and the trend participation rate)
NAWRU = estimated non-accelerating wage rate of unemployment
EG = employment in the government sector.

The identification of appropriate measures of the NAWRU draws on a number of different sources of information. As the starting point, a set of estimates is derived using the method described by Elmeskov (1993) and Elmeskov and MacFarlan (1993). This method essentially assumes that the change in wage inflation is linearly proportional to the gap between actual unemployment and the NAWRU. Assuming also that the NAWRU changes only gradually over time, successive observations on the changes in inflation and actual unemployment rates can then be used to calculate a time series corresponding to the implicit value of the NAWRU. More specifically, it is assumed that the change in the rate of wage inflation is proportional to the gap between actual unemployment and the NAWRU, thus:

$$D^2 \ln W = -\gamma(U - NAWRU); \qquad \gamma > 0 \qquad [6]$$

Table 1. **Contributions to growth in business sector potential output and NAWRUs**[1]

	Business sector potential output	Employment contribution	Trend hours	Capital contribution	Trend TFP	NAWRU	Actual unemployment
United States							
1986	2.9	1.4	-0.1	1.0	0.6	6.2	7.0
1987	2.6	1.2	-0.1	0.9	0.6	5.9	6.2
1988	2.4	1.0	0.0	0.9	0.6	5.7	5.5
1989	2.0	0.5	0.0	0.9	0.6	5.8	5.3
1990	1.9	0.5	0.0	0.8	0.6	5.8	5.5
1991	2.4	1.0	0.1	0.7	0.6	5.8	6.7
1992	2.3	0.9	0.1	0.6	0.7	6.0	7.4
1993	2.4	0.9	0.1	0.7	0.7	6.1	6.8
1994	2.7	0.9	0.1	0.9	0.7	6.2	6.1
1995	2.8	0.8	0.1	1.0	0.8	6.2	5.6
1996	2.7	0.8	0.1	1.1	0.8	6.2	5.6
Germany (Western)							
1986	1.8	–0.1	-0.5	0.8	1.6	7.3	7.7
1987	2.1	0.0	–0.5	0.8	1.7	7.3	7.6
1988	2.6	0.4	–0.5	0.9	1.8	7.2	7.6
1989	3.1	0.8	–0.5	0.9	1.9	7.0	6.9
1990	3.9	1.4	–0.5	1.0	1.9	6.9	6.2
1991	3.5	0.9	–0.5	1.2	1.9	6.8	5.5
1992	3.4	0.9	–0.5	1.1	1.8	6.9	5.8
1993	2.7	0.5	–0.4	0.8	1.7	7.0	7.3
1994	2.5	0.4	-0.4	0.7	1.7	7.1	8.2
1995	2.4	0.3	-0.4	0.7	1.7	7.2	7.9
1996	2.4	0.2	–0.4	0.8	1.7	7.3	7.5
France							
1986	2.3	–0.1	..	0.8	1.7	8.9	10.4
1987	2.7	0.2	..	0.8	1.6	9.0	10.5
1988	2.9	0.3	..	0.9	1.6	9.0	10.0
1989	3.0	0.4	..	1.0	1.5	9.0	9.4
1990	2.7	0.1	..	1.1	1.5	9.1	8.9
1991	2.4	0.0	..	1.0	1.4	9.1	9.5
1992	2.1	-0.2	..	0.9	1.4	9.2	10.4
1993	1.8	–0.3	..	0.7	1.4	9.2	11.7
1994	2.2	0.2	..	0.6	1.4	9.2	12.6
1995	2.3	0.3	..	0.6	1.4	9.2	12.3
1996	2.4	0.3	..	0.7	1.4	9.2	11.7
Italy							
1986	2.0	0.0	..	0.7	1.3	10.4	11.2
1987	1.6	–0.5	..	0.8	1.4	10.7	12.1
1988	2.7	0.4	..	0.9	1.4	11.0	12.1
1989	1.9	–0.5	..	0.9	1.4	11.0	12.1
1990	2.7	0.3	..	1.0	1.4	11.0	11.5
1991	2.5	0.1	..	0.9	1.5	11.0	11.0
1992	2.6	0.3	..	0.8	1.5	10.8	11.6
1993	2.4	0.3		0.5	1.6	10.5	10.4
1994	2.2	0.2		0.4	1.7	10.2	11.3
1995	2.4	0.2		0.4	1.7	9.8	11.2
1996	2.5	0.2		0.5	1.8	9.5	11.0

Table 1. **Contributions to growth in business sector potential output and NAWRUs**[1] *(cont'd)*

	Business sector potential output	Employment contribution	Capital contribution	Trend TFP	NAWRU	Actual unemployment
United Kingdom						
1986	2.7	0.3	0.6	1.9	10.2	11.0
1987	2.8	0.3	0.6	1.8	9.8	9.8
1988	3.1	0.6	0.8	1.7	9.3	7.8
1989	3.5	0.9	0.9	1.6	8.8	6.1
1990	3.0	0.6	0.7	1.6	8.4	5.9
1991	3.5	1.4	0.4	1.6	8.2	8.2
1992	3.1	1.2	0.3	1.7	8.0	9.9
1993	2.3	0.3	0.2	1.7	7.8	10.2
1994	2.3	0.3	0.2	1.8	7.7	9.4
1995	2.5	0.4	0.3	1.8	7.6	8.7
1996	2.6	0.4	0.4	1.9	7.5	7.9
Canada						
1986	2.6	0.9	1.3	0.4	9.0	9.5
1987	2.4	0.8	1.4	0.3	9.0	8.8
1988	3.1	1.1	1.7	0.3	9.0	7.8
1989	3.1	1.1	1.8	0.2	9.0	7.5
1990	3.0	1.2	1.6	0.2	9.0	8.1
1991	2.6	1.0	1.4	0.2	8.8	10.3
1992	2.0	0.6	1.1	0.3	8.6	11.3
1993	1.8	0.5	0.9	0.4	8.5	11.2
1994	2.7	1.2	1.0	0.5	8.5	10.5
1995	2.9	1.3	1.1	0.5	8.5	9.7
1996	3.0	1.3	1.2	0.6	8.5	9.2
Australia						
1986	3.3	1.2	1.2	0.9	7.9	8.0
1987	3.5	1.4	1.2	0.9	7.9	8.0
1988	3.7	1.5	1.3	0.9	8.0	7.1
1989	4.3	1.9	1.5	0.9	8.1	6.1
1990	3.2	1.0	1.2	0.9	8.3	7.0
1991	2.8	1.0	0.8	0.9	8.1	9.5
1992	3.3	1.6	0.7	0.9	8.0	10.7
1993	2.9	1.3	0.6	1.0	7.9	10.9
1994	2.9	1.2	0.7	1.0	7.8	9.7
1995	3.2	1.3	0.9	1.0	7.7	8.7
1996	3.4	1.3	1.0	1.0	7.6	7.9
Austria						
1986	1.1	–0.8	1.1	0.9	3.4	3.1
1987	1.9	0.0	1.1	0.9	3.5	3.8
1988	1.9	–0.1	1.2	0.8	3.5	3.6
1989	2.0	0.0	1.2	0.8	3.5	3.1
1990	3.6	1.4	1.3	0.8	3.5	3.2
1991	2.8	0.7	1.3	0.8	3.5	3.5
1992	2.3	0.3	1.2	0.8	3.5	3.6
1993	2.3	0.5	1.0	0.8	3.7	4.2
1994	2.2	0.4	1.1	0.8	3.9	4.4
1995	2.4	0.5	1.1	0.8	4.0	4.2
1996	2.6	0.7	1.2	0.8	4.0	4.1

Table I. **Contributions to growth in business sector potential output and NAWRUs[1]** *(cont'd)*

	Business sector potential output	Employment contribution	Capital contribution	Trend TFP	NAWRU	Actual unemployment
Belgium						
1986	2.0	-0.1	0.7	1.3	11.7	11.6
1987	2.7	0.6	0.8	1.3	11.5	11.3
1988	2.9	0.7	0.9	1.3	11.1	10.3
1989	2.8	0.4	1.1	1.2	10.9	9.3
1990	2.5	0.0	1.2	1.2	10.8	8.7
1991	2.7	0.4	1.1	1.2	10.8	9.3
1992	2.5	0.3	0.9	1.2	10.8	10.3
1993	2.4	0.5	0.7	1.2	10.8	11.9
1994	2.3	0.4	0.7	1.2	10.7	12.6
1995	2.6	0.6	0.8	1.2	10.5	12.1
1996	2.6	0.6	0.8	1.2	10.2	11.3
Denmark						
1986	3.1	0.4	1.3	1.4	8.6	7.8
1987	3.0	0.4	1.1	1.4	8.7	7.8
1988	2.6	0.3	0.9	1.4	8.9	8.6
1989	2.1	-0.3	1.0	1.4	9.2	9.3
1990	2.6	0.2	1.0	1.5	9.6	9.6
1991	2.7	0.4	0.8	1.5	10.0	10.5
1992	2.0	-0.1	0.6	1.5	10.4	11.2
1993	1.4	-0.7	0.6	1.5	10.4	12.2
1994	2.4	0.2	0.6	1.5	10.4	12.0
1995	2.4	0.1	0.7	1.5	10.4	10.8
1996	2.6	0.3	0.8	1.5	10.4	10.1
Finland						
1986	1.6	-1.5	0.9	2.2	6.8	5.4
1987	1.4	-1.7	0.9	2.2	8.0	5.1
1988	1.2	-1.9	0.9	2.2	9.4	4.5
1989	1.6	-1.8	1.2	2.2	10.8	3.5
1990	1.7	-1.5	1.0	2.2	12.2	3.5
1991	1.3	-1.3	0.5	2.2	13.7	7.6
1992	1.4	-0.9	0.1	2.2	15.2	13.1
1993	2.0	0.0	-0.1	2.2	16.4	17.9
1994	3.3	1.1	0.0	2.2	16.5	18.3
1995	3.2	0.9	0.1	2.2	16.3	16.3
1996	3.1	0.6	0.3	2.2	15.8	14.6
Greece						
1986	1.3	0.1	0.9	0.2	6.1	7.4
1987	1.0	0.1	0.7	0.2	7.0	7.4
1988	1.2	0.1	0.8	0.2	7.3	7.7
1989	1.4	0.1	1.2	0.2	7.5	7.5
1990	1.9	0.6	1.1	0.2	7.7	7.0
1991	1.5	0.4	0.9	0.2	7.9	7.7
1992	1.5	0.4	0.9	0.2	8.1	8.7
1993	1.3	0.4	0.7	0.2	8.1	8.2
1994	1.5	0.3	0.9	0.3	8.1	9.7
1995	1.6	0.4	0.9	0.3	8.0	10.0
1996	1.6	0.4	0.9	0.3	8.0	10.2

Table 1. **Contributions to growth in business sector potential output and NAWRUs**[1] *(cont'd)*

	Business sector potential output	Employment contribution	Capital contribution	Trend TFP	NAWRU	Actual unemployment
Ireland						
1986	3.3	–0.3	0.4	3.2	16.9	17.4
1987	3.9	0.2	0.5	3.2	17.4	17.5
1988	4.8	1.0	0.6	3.3	17.7	16.7
1989	6.1	2.1	0.7	3.3	17.2	15.6
1990	5.6	1.5	0.8	3.3	16.6	13.7
1991	5.0	1.1	0.6	3.3	16.1	15.7
1992	4.9	1.1	0.5	3.3	15.7	16.3
1993	4.6	0.9	0.4	3.3	15.4	16.7
1994	4.9	1.1	0.4	3.3	14.8	15.8
1995	4.4	0.5	0.5	3.3	14.8	15.3
1996	4.4	0.5	0.5	3.3	14.8	14.7
Netherlands						
1986	2.7	0.7	0.9	1.1	9.2	9.9
1987	2.6	0.7	0.8	1.1	9.3	9.6
1988	2.7	0.8	0.8	1.1	9.3	9.2
1989	2.6	0.6	0.9	1.1	9.3	8.3
1990	2.7	0.6	1.0	1.1	9.3	7.5
1991	2.8	0.7	1.0	1.1	9.3	7.0
1992	2.7	0.7	0.9	1.0	9.2	6.7
1993	2.4	0.6	0.8	1.0	9.1	8.3
1994	2.4	0.6	0.8	1.0	8.9	9.3
1995	2.5	0.6	0.8	1.0	8.7	8.6
1996	2.5	0.5	0.9	1.0	8.5	7.9
Norway (mainland)						
1986	2.2	0.7	1.0	0.5	3.1	2.0
1987	1.8	0.4	0.9	0.5	3.3	2.1
1988	1.6	0.3	0.7	0.6	3.7	3.2
1989	0.5	–0.6	0.4	0.6	4.1	4.9
1990	0.2	–0.8	0.4	0.6	4.5	5.2
1991	0.4	–0.6	0.3	0.7	4.9	5.5
1992	0.8	–0.3	0.3	0.7	5.2	5.9
1993	1.2	0.1	0.3	0.8	5.3	6.0
1994	1.2	0.0	0.4	0.8	5.4	5.5
1995	2.0	0.7	0.4	0.8	5.3	5.2
1996	2.2	0.9	0.5	0.8	5.1	4.8
Spain						
1986	1.4	–0.8	0.7	1.5	19.1	21.0
1987	2.7	0.1	1.1	1.5	19.4	20.5
1988	3.1	0.3	1.3	1.5	19.5	19.5
1989	2.8	–0.3	1.6	1.5	19.6	17.3
1990	2.9	–0.2	1.6	1.5	19.8	16.3
1991	2.9	–0.1	1.5	1.5	20.0	16.3
1992	2.8	0.1	1.3	1.5	20.3	18.4
1993	2.3	0.0	0.8	1.5	20.7	22.7
1994	2.1	0.0	0.6	1.5	21.0	24.3
1995	3.0	0.9	0.7	1.5	20.5	24.0
1996	3.1	0.9	0.7	1.5	20.0	23.4

Table 1. **Contributions to growth in business sector potential output and NAWRUs[1]** *(cont'd)*

	Business sector potential output	Employment contribution	Capital contribution	Trend TFP	NAWRU	Actual unemployment
Sweden						
1986	2.3	0.5	0.9	1.0	2.1	2.2
1987	2.8	0.8	1.0	1.0	2.1	1.9
1988	2.0	0.0	1.0	1.0	2.3	1.6
1989	1.9	−0.4	1.2	1.1	2.6	1.4
1990	0.4	−1.9	1.2	1.1	3.2	1.5
1991	1.9	−0.1	0.8	1.2	3.9	2.7
1992	2.2	0.5	0.5	1.2	4.8	4.8
1993	1.9	0.4	0.2	1.2	5.6	8.3
1994	2.1	0.5	0.4	1.3	6.3	7.9
1995	2.0	0.4	0.3	1.3	6.5	7.8
1996	2.0	0.3	0.4	1.3	6.5	7.5

	Business sector output potential	Potential employment	Trend hours	Capital stocks	Trend labour efficiency	NAWRU	Actual unemployment
Japan[2]							
1986	4.8	1.6	0.1	5.5	2.8	2.1	2.8
1987	4.4	1.2	0.1	5.1	2.9	2.3	2.9
1988	3.6	1.7	−1.5	5.4	2.9	2.2	2.5
1989	3.6	1.5	−1.5	6.3	2.9	2.3	2.3
1990	3.3	1.0	−1.5	6.9	2.9	**2.2**	2.1
1991	3.2	1.0	−1.5	7.0	2.9	2.2	2.1
1992	2.4	0.6	−1.5	6.2	2.5	2.2	2.2
1993	2.4	1.0	−1.5	5.0	2.4	2.2	2.5
1994	3.5	1.2	−0.2	3.8	2.4	2.2	2.9
1995	3.3	1.2	−0.3	3.5	2.4	2.2	3.0
1996	3.3	1.2	−0.3	3.4	2.4	2.2	2.9

1. Estimates for 1994 to 1996 are based on the economic projections reported in OECD Economic *Outlook* No. 56, December 1994.
2. Given that a CES production function is used for Japan, a comparable decomposition of potential is not available. The reported series are however. the most influential factors involved in the estimation procedure.

Source: OECD Secretariat

where D is the first-difference operator and W and U are the levels of wages and unemployment, respectively. Assuming that the NAWRU changes relatively slowly over time, an estimate of γ can be calculated for any two consecutive time periods as:

$$\gamma = -D^3 \ln W / DU \quad [7]$$

which, in turn, can be substituted into (6) to give the estimated NAWRU as:

$$NAWRU = U - (DU/D^3 \ln W) * D^2 \ln W \quad [8]$$

The resulting series are then smoothed to eliminate erratic movements.[10] As illustrated by Elmeskov *(op. cit.)*, such measures of the NAWRU come close to the results of comparable methods which use alternative Okun or Beveridge curve relationships as a starting point. For a number of major countries, this information has been supplemented by estimates based on recent wage equation estimates embedded in the supply blocks of the OECD INTERLINK model (see Turner *et al.*. 1993).along with a range of previous estimates. The broad set of NAWRU estimates were then cross-checked by OECD Secretariat country experts and modified where additional country information was available.

Potential output for the whole economy is finally obtained by adding actual value added in the government sector to business-sector potential output. Thus, for want of a superior alternative measure, actual value added in the government sector is taken to be equal to potential output in that sector. The calculation of potential output growth and the decomposition into its various components is illustrated schematically in the Box, and the decomposition into main components is provided in Table 1.

For Japan, a slightly different approach is used from the one outlined above. In particular, the most recent Secretariat estimates of the business sector production function for Japan (see Turner *et al.*, *op. cit.*) suggest that the Cobb-Douglas production function is inappropriate and instead a CES production function is used, one with an estimated elasticity of substitution between capital and labour of 0.4. In this case, the decomposition of potential output growth into its component parts is more complex than shown above.

Comparison of results

A general comparison of estimated potential growth rates and output gaps for each country with previous split time-trend and HP trend estimates is provided in Table 2 and Figure 1. There are several general features to note. Firstly, the symmetry properties are different. The calculation of trend output using a split time-trend or HP filter imposes the property that the output gaps are symmetric (*i.e.* they sum to zero) over the full estimation period even if the economy is not at the same point in the cycle at the beginning and the end of the period.]' In contrast, such symmetry is not imposed on the measures of potential and will depend on the relative positions of actual and NAWRU rates of unemployment – in particular the potential measure will only be exactly symmetric if the NAWRU estimate is exactly equal to average unemployment over the cycle.[12]

Table 2. **Potential output growth rates and output gaps under different methods'**

	GDP growth rates				Output gaps		
	Actual	Previous method	Hodrick-Prescott	Potential	Previous method	Hodrick-Prescott	Potential
United States							
1987	3.1	2.6	2.9	2.5	1.0	0.7	0.2
1988	3.9	2.6	2.7	2.4	2.3	1.9	1.7
1989	2.5	2.4	2.5	2.0	2.5	1.9	2.2
1990	1.2	2.3	2.3	2.1	1.4	0.9	1.4
1991	−0.6	2.2	2.2	2.2	−1.4	−1.9	−1.4
1992	2.3	2.2	2.2	2.2	−1.3	−1.8	−1.3
1993	3.1	2.3	2.3	2.3	−0.5	−1.1	−0.4
1994	3.9	2.4	2.4	2.5	1.0	0.4	1.0
1995	3.1	2.4	2.4	2.5	1.6	1.0	1.5
1996	2.0	2.4	2.4	2.5	1.2	0.6	1.0
Japan							
1987	4.1	4.1	4.2	4.1	−1.9	−1.5	−3.8
1988	6.2	4.1	4.2	3.4	0.1	0.4	−1.2
1989	4.7	4.1	4.0	3.3	0.7	1.1	0.1
1990	4.8	4.0	3.6	3.2	1.5	2.3	1.8
1991	4.3	3.8	3.2	2.9	1.9	3.4	3.1
1992	1.1	3.6	2.8	2.3	−0.5	1.8	2.0
1993	0.1	3.5	2.5	2.2	−3.8	−0.6	−0.2
1994	1.0	3.4	2.4	3.2	−6.0	−2.0	−2.3
1995	2.5	3.4	2.5	3.0	−6.9	−2.0	−2.8
1996	3.4	3.4	2.7	3.0	−6.9	−1.3	−2.5
Germany[2]							
1987	1.5	2.2	2.7	2.0	−2.8	−1.9	−1.8
1988	3.7	2.2	3.0	2.4	−1.3	−1.2	−0.5
1989	3.6	2.2	3.1	2.8	0.1	−0.7	0.2
1990	5.7	2.6	3.1	3.6	3.1	1.7	2.3
1991	5.0	2.6	3.0	3.2	5.1	3.5	3.8
1992	2.2	3.0	3.0	3.5	4.3	2.7	2.5
1993	−1.1	2.9	2.6	2.6	0.3	−1.1	−1.2
1994	2.8	2.8	2.8	2.8	0.3	−1.1	−1.2
1995	2.8	2.6	2.8	2.8	0.6	−1.0	−1.1
1996	3.5	2.6	2.9	2.9	1.4	−0.4	−0.5
France							
1987	2.3	2.5	2.2	2.4	−3.1	−1.6	−2.3
1988	4.5	2.5	2.2	2.6	−1.2	0.6	−0.5
1989	4.3	2.5	2.2	2.6	0.5	2.6	1.1
1990	2.5	2.5	2.2	2.4	0.5	3.0	1.2
1991	0.8	2.5	2.1	2.2	−1.1	1.6	−0.2
1992	1.2	2.5	2.1	2.0	−2.4	0.7	−1.0
1993	−1.0	2.5	2.1	1.9	−5.7	−2.3	−3.7
1994	2.2	2.5	2.2	2.0	−6.0	−2.3	−3.5
1995	3.1	2.5	2.2	2.1	−5.5	−1.5	−2.6
1996	3.2	2.5	2.3	2.2	−4.9	−0.6	−1.6

Table 2. **Potential output growth rates and output gaps under different methods**[1] *(cont'd)*

	GDP growth rates				output gaps		
	Actual	Previous method	Hodrick-Prescott	Potential	Previous method	Hodrick-Prescott	Potential
Italy							
1987	3.1	2.4	2.5	1.7	−1.0	−0.3	1.5
1988	4.1	2.4	2.5	2.6	0.6	1.2	2.9
1989	2.9	2.4	2.3	1.8	1.2	1.8	4.0
1990	2.1	2.4	2.1	2.5	0.9	1.9	3.7
1991	1.2	2.4	1.8	2.3	−0.3	1.3	2.6
1992	0.7	2.4	1.7	2.5	−1.9	0.3	0.8
1993	−0.7	2.4	1.7	2.3	−4.8	−2.0	−2.1
1994	2.2	2.4	1.8	2.1	−5.0	−1.7	−2.0
1995	2.7	2.4	2.0	2.0	−4.8	−1.0	−1.4
1996	2.9	2.4	2.2	2.2	−4.3	−0.4	−0.7
United Kingdom							
1987	4.8	2.6	2.5	2.5	3.0	2.6	2.8
1988	5.0	2.6	2.4	2.8	5.5	5.2	5.0
1989	2.2	2.6	2.3	2.7	5.1	5.1	4.6
1990	0.4	2.6	2.1	2.7	2.9	3.3	2.2
1991	−2.0	2.3	2.0	2.8	−1.3	−0.7	−2.5
1992	−0.5	2.3	2.0	2.3	−4.0	−3.2	−5.1
1993	2.0	2.3	2.1	2.1	−4.2	−3.2	−5.2
1994	3.5	2.3	2.2	2.1	−3.0	−2.0	−3.9
1995	3.4	2.3	2.3	2.3	−1.9	−1.0	−2.9
1996	3.0	2.3	2.4	2.4	−1.2	−0.4	−2.3
Canada							
1987	4.2	3.0	2.7	2.6	1.3	2.2	2.6
1988	5.0	3.0	2.6	3.0	3.3	4.6	4.6
1989	2.4	3.0	2.5	3.0	2.7	4.6	4.0
1990	−0.2	2.7	2.4	2.9	−0.2	1.9	0.8
1991	−1.8	2.5	2.4	2.6	−4.5	−2.3	−3.5
1992	0.6	2.5	2.4	2.0	−6.2	−4.0	−4.8
1993	2.2	2.5	2.5	1.8	−6.5	−4.3	−4.4
1994	4.1	2.7	2.6	2.5	−5.2	−2.8	−2.9
1995	4.2	3.0	2.7	2.9	−4.2	−1.4	−1.7
1996	3.9	3.0	2.8	3.0	−3.3	−0.3	−0.8
Australia							
1987	4.7	4.1	3.4	3.4	0.7	0.9	0.6
1988	4.1	4.1	3.2	3.4	0.7	1.7	1.3
1989	4.5	4.1	3.0	3.6	1.1	3.3	2.2
1990	1.3	2.7	2.7	3.1	−0.3	1.9	0.4
1991	−1.3	2.7	2.6	2.7	4.2	−2.0	−3.4
1992	2.1	2.7	2.7	2.8	−4.8	−2.6	−4.1
1993	3.8	2.7	2.9	2.5	−3.9	−1.7	−2.9
1994	4.3	2.7	3.1	2.8	−2.4	−0.6	−1.4
1995	4.3	2.7	3.3	3.0	−1.0	0.3	−0.2
1996	4.0	2.7	3.4	3.1	0.2	0.8	0.6

Table 2. **Potential output growth rates and output gaps under different methods**[1] *(cont'd)*

	GDP growth rates				Output gaps		
	Actual	Previous method	Hodrick-Prescott	Potential	Previous method	Hodrick-Prescott	Potential
Austria							
1987	1.7	2.2	2.4	1.9	−2.3	−2.0	−4.3
1988	4.1	2.2	2.6	1.9	−0.6	−0.6	−2.3
1989	3.8	3.0	2.7	2.0	0.2	0.5	−0.5
1990	4.2	3.0	2.7	2.9	1.4	2.0	0.8
1991	2.7	3.0	2.6	2.8	1.2	2.1	0.7
1992	1.6	3.0	2.5	2.2	−0.2	1.2	0.1
1993	−0.3	2.2	2.4	2.1	−2.6	−1.4	−2.2
1994	2.6	2.2	2.4	2.1	−2.2	−1.2	−1.7
1995	3.0	2.2	2.5	2.2	−1.5	−0.6	−0.9
1996	3.1	2.2	2.5	2.4	−0.6	−0.1	−0.3
Belgium							
1987	2.0	2.0	2.3	2.2	−2.7	−1.9	−2.5
1988	4.9	2.0	2.5	2.6	0.1	0.3	−0.4
1989	3.5	2.0	2.6	2.4	1.6	1.2	0.7
1990	3.2	2.0	2.5	2.3	2.8	2.0	1.6
1991	2.3	2.0	2.3	2.2	3.1	2.0	1.7
1992	1.9	2.0	2.1	2.1	3.0	1.7	1.5
1993	−1.7	2.0	2.0	2.1	−0.7	−1.9	−2.3
1994	2.3	2.0	2.0	2.1	−0.4	−1.7	−2.1
1995	3.0	2.0	2.1	2.3	0.7	−0.8	−1.3
1996	3.1	2.0	2.3	2.4	1.8	0.0	−0.7
Denmark							
1987	0.3	2.0	2.0	2.6	0.9	1.4	0.7
1988	1.2	2.0	1.7	2.5	0.0	0.9	−0.6
1989	0.6	2.0	1.6	1.7	−1.4	−0.2	−1.7
1990	1.4	2.0	1.6	2.2	−1.9	−0.3	−2.5
1991	1.0	2.0	1.7	2.2	−2.9	−1.0	−3.6
1992	1.2	2.0	1.9	1.8	−3.6	−1.6	−4.1
1993	1.4	2.0	2.1	1.5	−4.1	−2.3	−4.2
1994	4.7	2.0	2.4	2.3	−1.6	0.0	−1.9
1995	3.3	2.0	2.6	2.1	−0.3	0.6	−0.8
1996	2.9	2.0	2.7	2.2	−0.6	0.8	−0.1
Finland							
1987	4.1	2.5	2.6	1.7	3.4	0.2	4.0
1988	4.9	2.3	2.0	1.4	6.0	3.0	7.6
1989	5.7	2.0	1.3	1.6	9.9	7.4	11.9
1990	0.0	0.9	0.5	1.7	8.9	6.9	10.0
1991	−7.1	0.9	0.0	1.3	0.3	−0.6	0.9
1992	−3.6	0.9	−0.1	0.8	−4.2	−4.2	−3.5
1993	−2.0	0.9	0.3	0.9	−7.0	−6.4	−4.3
1994	3.5	0.9	1.1	2.1	−4.5	−4.1	−5.0
1995	4.8	0.9	1.8	2.2	−0.8	−1.3	−2.5
1996	3.9	0.9	2.5	2.6	2.1	0.1	−1.3

Table 2. **Potential output growth rates and output gaps under different methods**[1] *(cont'd)*

	GDP growth rates				Output gaps		
	Actual	Previous method	Hodrick-Prescott	Potential	Previous method	Hodrick-Prescott	Potential
Greece							
1987	-0.5	1.7	1.8	1.0	-2.1	-2.2	-4.1
1988	4.4	1.7	1.8	1.2	0.5	0.3	-1.1
1989	4.0	1.7	1.8	1.8	2.8	2.5	1.1
1990	-1.0	1.7	1.6	1.6	0.1	-0.1	-1.4
1991	3.2	1.7	1.5	1.4	1.5	1.5	0.3
1992	0.8	1.7	1.3	1.3	0.6	1.0	-0.2
1993	-0.5	1.7	1.3	1.2	-1.6	-0.8	-1.9
1994	1.0	1.7	1.3	1.4	-2.3	-1.2	-2.3
1995	1.5	1.7	1.4	1.4	-2.5	-1.1	-2.3
1996	2.3	1.7	1.6	1.5	-2.0	-0.5	-1.5
Ireland							
1987	5.7	3.3	3.8	3.6	-2.3	-2.4	-3.9
1988	4.3	4.7	4.4	4.0	-2.6	-2.5	-3.6
1989	7.4	4.7	4.8	5.1	-0.1	-0.1	-1.6
1990	8.6	4.7	5.1	5.2	3.6	3.2	1.6
1991	2.9	4.7	5.1	4.8	1.8	1.0	-0.2
1992	5.0	4.7	5.1	4.7	2.2	1.0	0.1
1993	4.0	4.7	5.0	4.3	1.5	0.0	-0.2
1994	5.0	4.7	4.9	4.8	1.7	0.1	-0.1
1995	5.0	4.7	4.8	4.3	2.0	0.2	0.6
1996	4.6	4.7	4.7	4.3	1.9	0.1	0.9
Netherlands							
1987	1.2	2.2	2.4	2.5	-2.1	-1.0	-3.5
1988	2.6	2.2	2.6	2.3	-1.7	-1.0	-3.3
1989	4.7	2.2	2.7	2.3	0.7	0.8	-1.0
1990	4.1	2.2	2.7	2.4	2.6	2.2	0.7
1991	2.1	2.2	2.6	2.4	2.5	1.8	0.4
1992	1.4	2.2	2.4	2.4	1.7	0.8	-0.6
1993	0.4	2.2	2.4	2.2	-0.1	-1.2	-2.3
1994	2.5	2.2	2.4	2.2	0.2	-1.1	-2.1
1995	2.9	2.2	2.4	2.3	0.9	-0.7	-1.5
1996	3.2	2.2	2.5	2.4	1.9	0.0	-0.7
Norway (mainland)							
1987	1.2	0.7	1.4	2.3	5.6	4.0	5.0
1988	-1.7	1.2	0.9	1.8	2.5	1.3	1.4
1989	-2.2	1.8	0.6	1.3	-1.5	-1.6	-2.1
1990	1.1	1.8	0.6	0.8	-2.2	-1.1	-1.9
1991	-0.6	1.8	0.8	1.4	-4.5	-2.6	-3.8
1992	2.1	1.8	1.2	1.6	-4.3	-1.7	-3.3
1993	2.0	1.8	1.6	1.5	-4.1	-1.3	-2.9
1994	3.1	1.8	1.9	2.2	-2.9	-0.2	-2.1
1995	2.7	1.8	2.2	1.9	-2.0	0.4	-1.3
1996	2.5	1.8	2.4	2.0	-1.4	0.2	-0.8

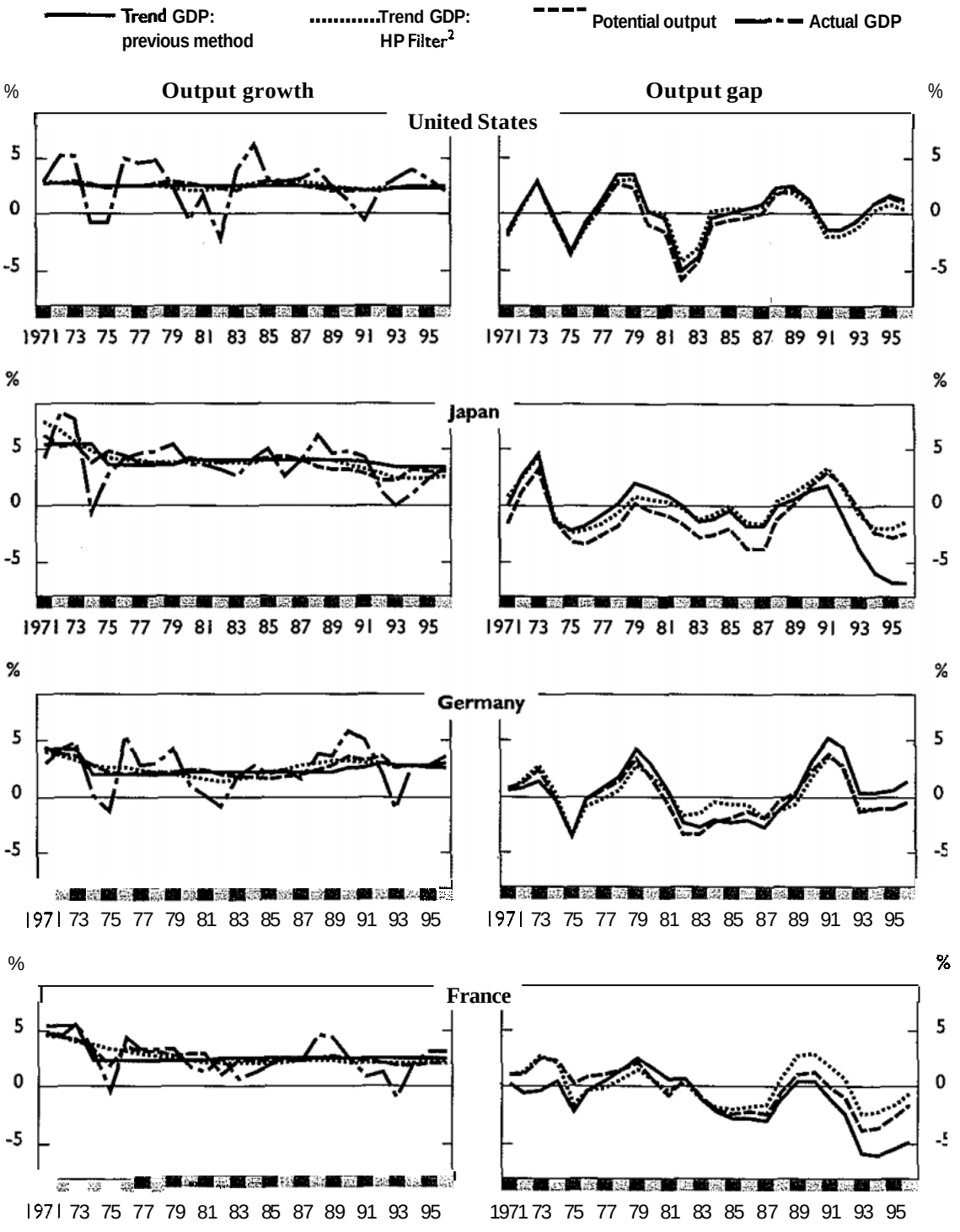
Table 2. **Potential output growth rates and output gaps under different methods**[1] *(cont'd)*

	GDP growth rates				Output gaps		
	Actual	Previous method	Hodrick-Prescott	Potential	Previous method	Hodrick-Prescott	Potential
Portugal							
1987	5.3	3.0	3.2	3.0	−2.0	−0.5	−2.0
1988	3.9	3.0	3.3	3.0	**−1.1**	0.1	−1.1
1989	5.2	3.0	3.2	3.0	1.0	2.0	1.0
1990	4.4	2.5	3.0	2.5	2.8	3.4	2.8
1991	**2.1**	2.5	2.6	2.5	2.5	3.0	2.5
1992	1.1	2.5	2.2	2.5	**1.1**	1.8	1.1
1993	−1.1	2.5	2.0	2.5	−2.4	−1.2	−2.4
1994	1.0	2.5	2.0	2.5	−3.9	−2.2	−3.9
1995	2.6	2.5	2.1	2.5	−3.8	**−1.7**	−3.8
1996	2.9	2.5	2.4	2.5	−3.4	**−1.2**	−3.4
Spain							
1981	5.6	3.0	3.5	2.7	0.1	-0.1	−0.9
1988	5.2	3.0	3.6	3.1	2.2	1.4	1.1
1989	4.7	3.0	3.4	3.4	4.0	2.7	2.5
1990	3.6	3.0	3.1	3.2	4.6	3.2	2.9
1991	2.2	3.0	2.7	3.1	3.8	2.8	2.0
1992	0.8	3.0	2.3	2.8	1.6	1.3	0.0
1993	−1.0	3.0	2.1	2.0	−2.4	−1.8	−2.9
1994	1.7	3.0	2.2	2.0	−3.6	−2.3	−3.2
1995	2.9	3.0	2.4	2.7	−3.7	−1.8	−3.0
1996	3.3	3.0	2.6	2.8	−3.4	−1.1	−2.6
Sweden							
1987	3.1	1.7	2.0	2.1	4.6	0.9	3.1
1988	2.3	1.7	1.7	1.8	5.2	1.5	3.6
1989	2.4	1.5	1.3	2.2	6.1	2.6	3.8
1990	1.4	1.5	0.9	0.5	5.9	3.1	4.7
1991	−1.1	1.3	0.6	1.6	3.4	1.6	2.0
1992	−1.9	1.3	0.4	1.3	0.1	−0.6	−1.3
1993	−2.1	1.3	0.5	1.0	−3.2	−2.9	−4.3
1994	2.3	1.3	0.9	1.3	−2.2	−1.9	−3.9
1995	2.3	1.3	1.2	1.5	−1.3	−1.6	−4.1
1996	2.5	1.3	1.6	1.6	−2.7	−1.3	−4.1

1. Estimates for 1994 to 1996 are based on the economic projections reported in *OECD Economic Outlook*, No. 56, December 1994.
2. Data up to end-1990 are for western Germany only: unless otherwise indicated, they are for the whole of Germany from 1991 onwards. In tables showing percentage changes from the previous year, data refer to the whole of Germany from 1992 onwards.

source: OECD Secretariat.

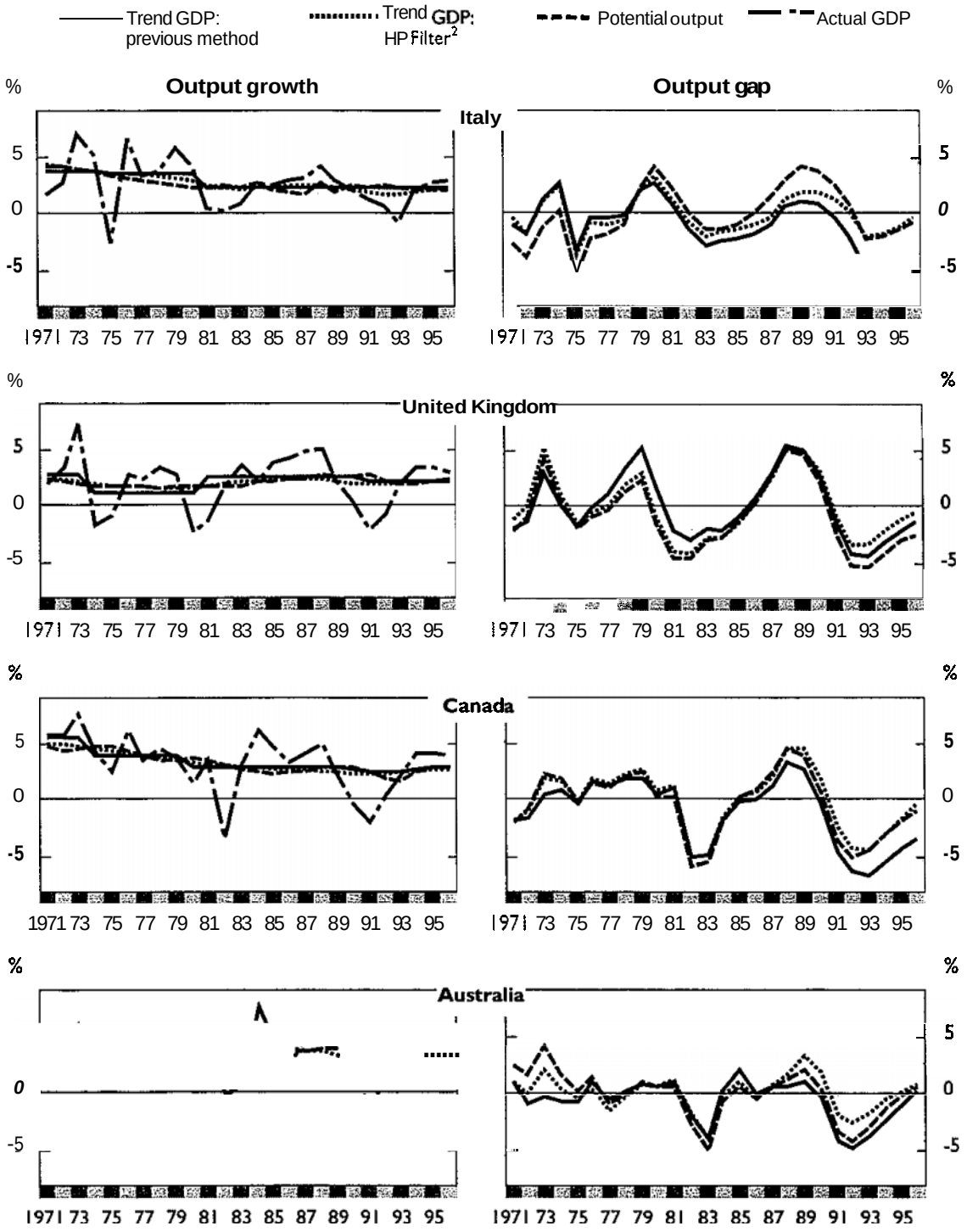
Figure 1. ***Output* growth and *output gaps*[1]**



1. **Estimates for** 1994 **to 1996 are based** on **the projections reported in the** OECD Economic Outlook 56, **December** 1994.
2. **Using lambda =** 25, **except for France and United Kingdom (100) and Canada (200).**

Source: **OECD Secretariat.**

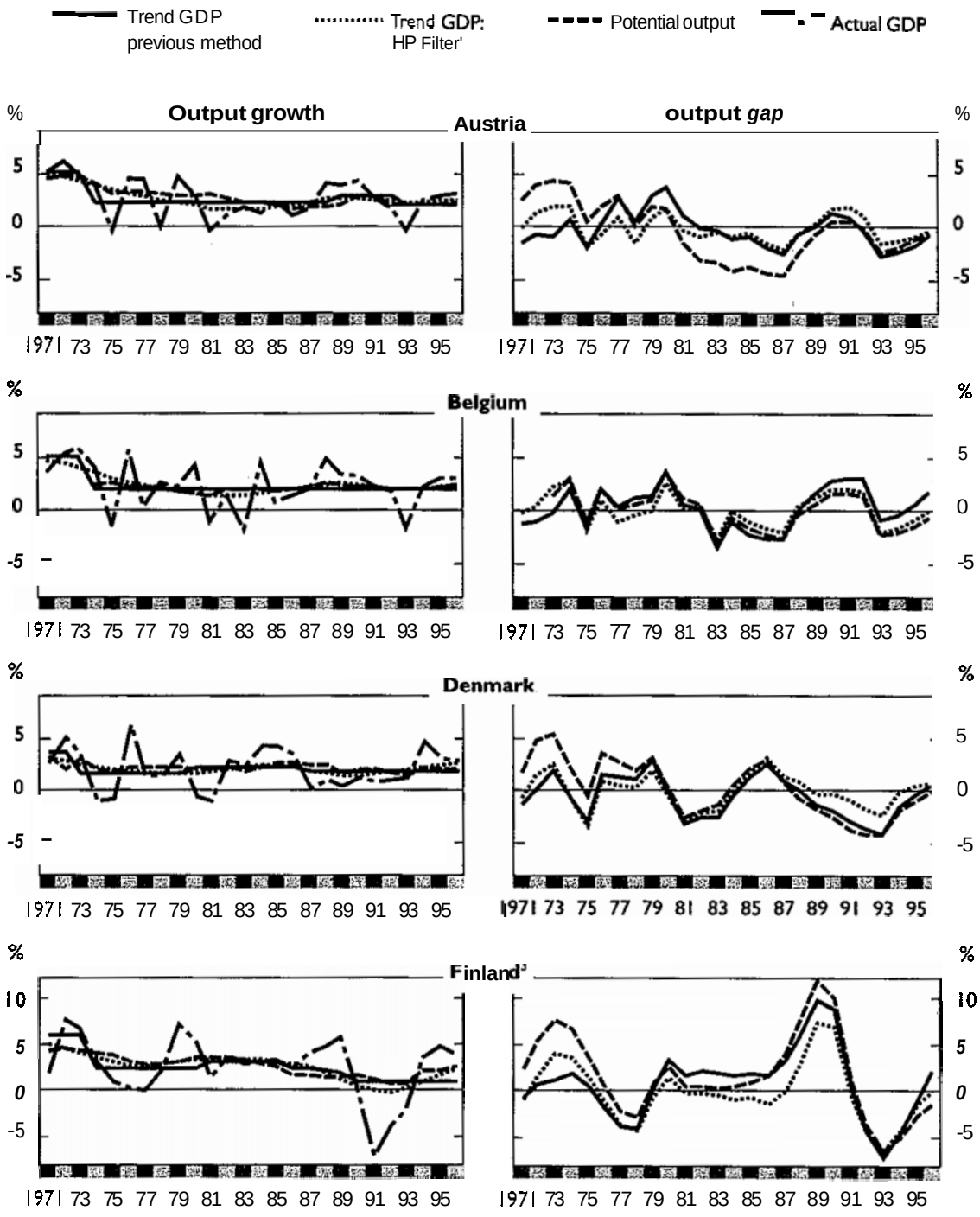
Figure 1. (con't) ***Output growth and output gaps'***



1. Estimates for 1994 to 1996 are based on the projections reported in the OECD Economic *Outlook* 56, December 1994.
2. Using lambda = 25, except for France and United Kingdom (100) and Canada (200).

Source: OECD Secretariat

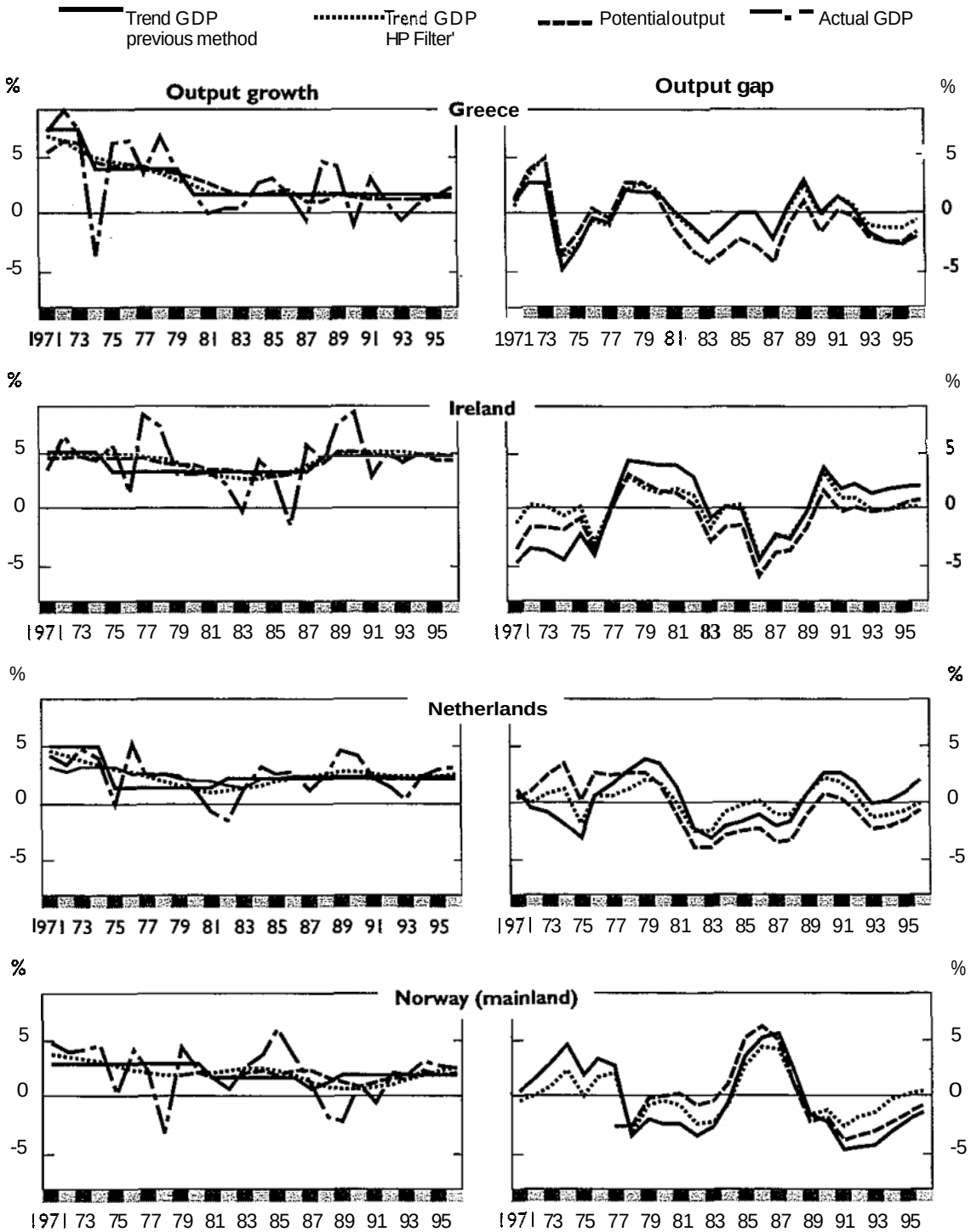
Figure I. (con't.) *Output* growth *and output gaps*[1]



1. Estimates for 1994 to 1996 are based on the projections reported in the OECD Economic Outlook 56, December 1994.
2. Using lambda = 25.
3. Different scale.

Source: OECD Secretariat

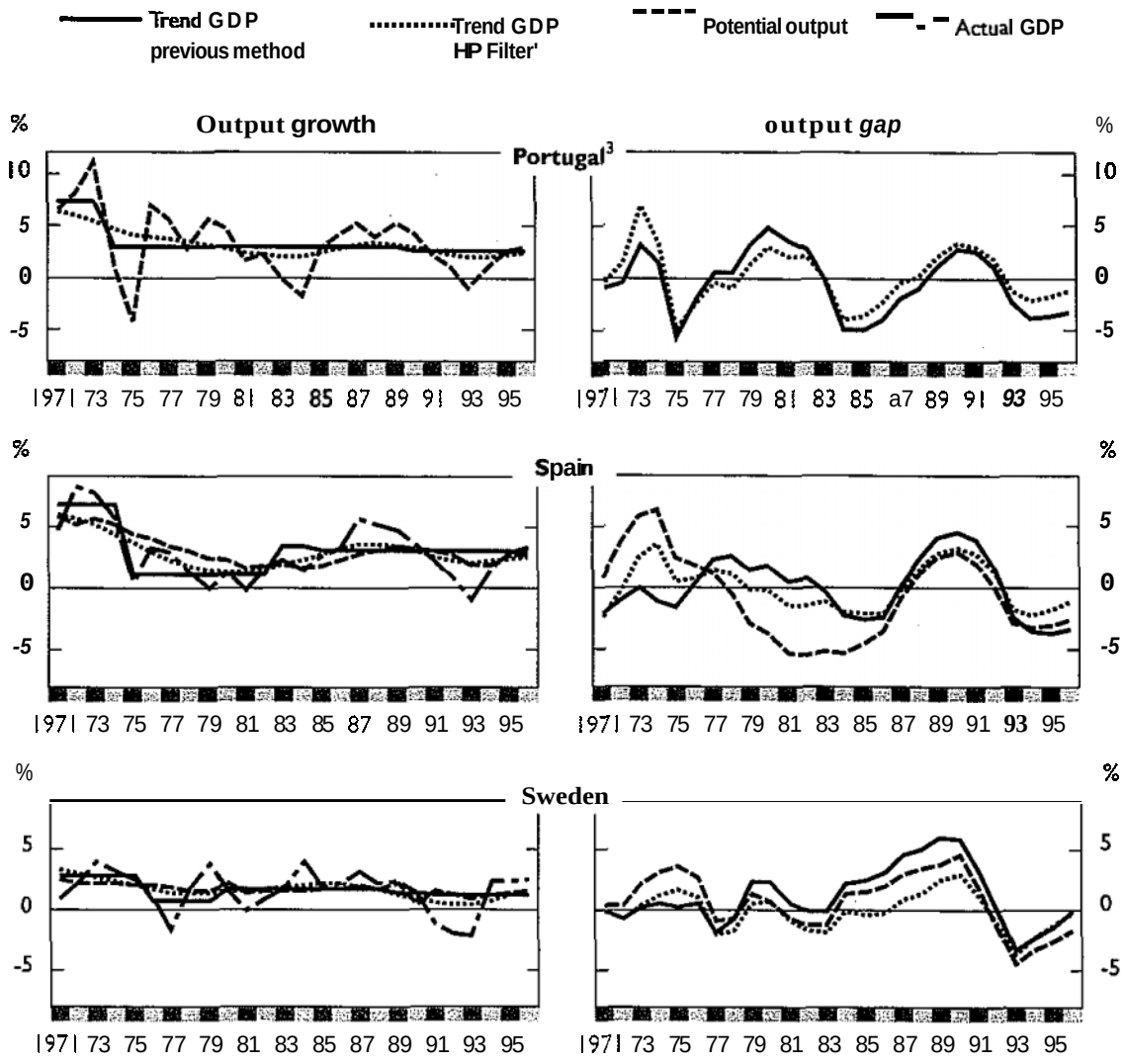
Figure I. (con't.) *Output growth and output gaps'*



1. Estimates for 1994 to 1996 are based on the projections reported in the OECD Economic Outlook 56, December 1994
2. Using lambda = 25.

Source OECD Secretariat.

Figure 1. *(con't)* **Output *growth and* output *gaps*[1]**



1. Estimates for 1994 to 1996 are based on the projections reported in the *OECD* Economic Outlook 56, December 1994.
2. Using lambda = 25.
3. Different scale.

Source: OECD Secretariat

Another important feature is that estimated potential output growth rates may fluctuate from year to year, more so than trend growth rates derived from output smoothing. Using the decomposition of contributions to potential growth shown in Table 1, the non-cyclical factors contributing to such variability are seen to vary from country to country. The three most important factors are variations in the NAWRU, the growth of capital stock and working-age population.

Since NAWRU estimates are necessarily imprecise and subject to a range of measurement problems it is useful to provide some sensitivity analysis for the resulting estimates of potential output and output gaps. In practice, the consequences of choosing a higher or lower NAWRU estimate on the estimated level of potential output are quite straightforward and are inversely related to the "labour share" of business sector output. Thus for the United States, with an average labour share of 68 per cent, assuming a NAWRU estimate which is ½ percentage point lower over the sample period would raise the level of business sector potential output by 0.3 to 0.4 per cent, implying a corresponding shift in the estimate of the gap between actual and potential GDP. Since this only entails a shift in the level of potential GDP, the consequences for estimates of the average growth rate of potential output are negligible or zero. Since the average labour shares of other OECD countries typically vary between 65 to 75 per cent, their sensitivity to variations in NAWRU estimates are broadly similar to the United States case.

Comparing across output gap estimates in Figure 1, the main turning points and broad characteristics are seen, with some exceptions, to be broadly consistent for each country, though this is also a reflection of the major peaks and troughs in the growth of actual GDP. Over the sample period up to the start of the recent recession, the broad developments shown for most countries are highly correlated across measures, though with varying degrees of differences. In general, the HP filter-based measures tend to suggest cycles of slightly lesser amplitude and hence smaller output gaps than either potential or split time trend measures, reflecting the specific values of the λ parameter used in the calculation. For most countries however, these differences do not seem to be large.

There are however a number of exceptions – most notably for Austria, Finland, Japan, Norway and Spain – where one or other measure behaves differently over some part of the sample. For the potential measure, the factors responsible can be readily identified with specific information and assumptions about non-cyclical or discrete changes in supply factors – shifts in working hours, capital stock, participation rates, working population and/or the NAWRU estimates (as reported in Table 1).[13] For the time series measures, these factors are not taken into account and differences in the trend estimates simply reflect developments in GDP over time, given the chosen values of the smoothing parameter or the dating of the peaks, depending on the method used.

Over the period of more immediate concern, – the recent past, the present and the projection period – there is clearer evidence of systematic differences, reflecting the inherent problems in projecting the split time trend through to the end of the current cycle. Most noticeably for Canada, France, Italy and Japan, the split time trend measures give much larger estimates of the output gap than either potential or the HP filter for the current projection period. Moreover in each of these cases the measures given by potential and HP methods are much closer over the recent past.

These results underscore the need For consistent judgement and hence a framework of assessment in which the behavioural assumptions underlying the

projection can be clearly identified and, as necessary, challenged and adjusted according to new information *i.e.* a process which goes beyond the mechanical application of time series methods to GDP. The latter are nonetheless useful where significant deviations of the potential estimates from a suitably calibrated trend may signal the need for a closer examination of the underlying macroeconomic and structural assumptions being made – either about the estimate of potential or the medium-term projections. For these reasons, the preferred approach is to use the potential measure, subject to its plausibility being checked against a suitably selected time series estimate of trend GDP.

ESTIMATING STRUCTURAL BUDGET BALANCES

The overall purpose of adjusting government balances for changes in economic activity is to obtain a clearer picture of the underlying fiscal situation and to use this as a guide to fiscal policy analysis. The structural budget balance represents what government revenues and expenditures would be if output was at its potential level and therefore attempts to abstract from cyclical developments in economic activity. In contrast, the actual budget balance also reflects the cyclical effects of economic activity and therefore fluctuates around the structural budget balance. Structural budget balances are therefore estimated by taking actual government revenues and expenditures and breaking them into estimated cyclical and structural components.

Estimation methods

In practice, the structural components of the budget balance are calculated from actual tax revenues and government expenditures, adjusted proportionately, according to the ratio of potential output to actual output and corresponding elasticity assumptions. Thus:

$$B^* = \Sigma T^{i*} - G^* - \text{capital spending} \qquad [9]$$

where: B^* = structural budget balance
T^{i*} = structural tax revenues for the ith category of tax
G^* = structural government expenditures (excluding capital spending)

and:

$$\frac{T^{i*}}{T^i} = \left[\frac{Y^*}{Y}\right]^{\alpha_i} \qquad \frac{G^*}{G} = \left[\frac{Y^*}{Y}\right]^{\beta} \qquad [10]$$

where: T^i = actual tax revenues for the ith category of tax
G = actual government expenditures (excluding capital spending)
Y = level of actual output
Y^* = level of potential output
α_i = elasticity of ith tax category with respect to output
β = elasticity of current government expenditures with respect to output

From relationships [9] and [10], the structural budget balance is derived as follows:

$$B^* = \sum_{i=1}^{4} T^i \left[\frac{Y^*}{Y} \right]^{\alpha_i} - G \left[\frac{Y^*}{Y} \right]^{\beta} - \text{capital spending} \qquad \alpha_i > 0 \qquad \beta < 0. \quad [11]$$

In practice, the split between estimated cyclical and structural components is sensitive to the estimated output gaps. Typically, if the estimated output gap were 1 percentage point of GDP smaller, the estimated structural component of the actual budget balance would be larger by around 1/2 percentage point of GDP. Estimates of the impact of economic activity on budget balances also indicate that tax revenue adjustments far outweigh the effect of expenditure adjustments, which make up only about 10 to 20 per cent of the adjustment. This is because almost all taxes are affected by economic fluctuation, whereas a much smaller proportion of expenditure is spent on unemployment and of that, only a portion is cyclical.

Elasticity assumptions

In making the above adjustments, separate elasticity estimates are used for each of the tax and expenditure categories considered. Taxes are typically divided

Table 3. **Tax elasticities**

	Corporate	Personal	Indirect	Social security
United States	2.5	1.1	1.0	*0.8*
Japan	3.7	1.2	1.0	*0.6*
Germany	2.5	*0.9*	1.0	0.7
France	3.0	1.4	1.0	**0.7**
Italy	2.9	0.4	1.0	0.3
United Kingdom	4.5	1.3	1.0	1.0
Canada	2.4	1.0	1.0	*0.8*
Australia	2.5	0.8	1.0	*0.8*
Austria	2.5	1.2	1.0	0.5
Belgium	2.5	1.2	1.0	0.8
Denmark	2.2	*0.7*	1.0	*0.6*
Finland	2.5	1.1	1.0	0.8
Greece	2.5	1.2	1.0	0.5
Ireland	2.5	1.3	1.0	0.5
Netherlands	2.5	1.3	1.0	1.0
Norway	2.5	1.2	1.0	0.9
Portugal	2.5	1.2	1.0	0.5
Spain	2.1	1.9	1.0	1.1
Sweden	2.4	1.4	1.0	1.2

Source: OECD Secretariat.

into four categories – corporate taxes, personal income taxes, social security contributions and indirect taxes – and a summary of relevant elasticity assumptions is given in Table 3.

For household income tax and social security contributions, average and marginal tax and contribution rates are applied to each level of income (and different family circumstance) based on information compiled by the Directorate for Financial, Fiscal and Enterprise Affairs of the OECD Secretariat. These average and marginal tax rates are then weighted together on the basis of weights derived from income distributions estimated from data provided in the July 1993 issue of the *OECD Employment Outlook* (see Annex I for details). The ratio between marginal tax and average tax provides an estimate of the elasticity of taxes with respect to gross earnings, which, in turn, can be converted to a GDP elasticity basis, allowing for cross-country variations in the responsiveness of employment and wages to fluctuations in GDP. The elasticities for corporate and indirect taxes are presented

Table 4. **Cyclical effects on government spending**

	Elasticity of Unemployment rate to output[1]	Okun coefficient	Elasticity of Unemployment-related expenditure to output	Elasticity of current primary government expenditure to output
			Expressed as a per cent of government expenditure	
	A		B	C = A × B
United States	0.5	2.0	–0.2	–0.1
Japan	0.1	6.7	–0.4	–0.1
Germany	0.3	3.3	–0.6	–0.2
France	0.3	3.3	–0.3	–0.1
Italy	0.2	5.0	–0.1	0.0
United Kingdom	0.5	2.0	–0.3	–0.1
Canada	0.4	2.5	–0.8	–0.3
Australia	0.4	2.5	–0.4	–0.2
Austria	0.2	5.0	–0.6	–0.1
Belgium	0.4	2.5	–0.3	–0.1
Denmark	0.4	2.5	–0.6	–0.2
Finland	0.3	3.3	–0.4	–0.1
Ireland	0.4	2.5	–0.5	–0.2
Netherlands	0.5	2.0	–0.5	–0.2
Norway	0.2	5.0	–0.4	–0.1
Spain	0.6	1.7	–0.4	–0.3
Sweden	0.2	5.0	–0.6	–0.1
Average	0.35	3.34	–0.44	–0.14

1. Increase in unemployment rate (in percentage points) following a 1 per cent reduction in GDP relative to trend.
Source: OECD Secretariat.

Table 5. **Unemployment expenditure and total general government expenditure**
Per cent of GDP. 1993

	Unemployment expenditure/ GDP[1]	General government expenditure/GDP	Unemployment expenditure/ government expenditure
United States	0.7[2]	34.5	2.0
Japan	0.4[3]	34.0	1.0
Germany	4.2	49.4	8.5
France	3.0[4]	54.9	5.5
Italy	1.8[4]	56.2	3.3
United Kingdom	1.8[2]	43.6	4.0
Canada	2.7[2]	49.7	5.3
Australia	2.7[3]	37.7	7.1
Austria	1.8	52.9	3.3
Belgium	4.0[4]	58.2	6.9
Denmark	6.8	63.1	10.7
Finland	6.9	61.0	11.3
Greece	1.24	52.4	2.3
Ireland	4.35	43.6	9.8
Netherlands	3.44	55.9	6.0
Norway	2.9	57.1	5.1
Portugal	1.9	52.9	3.6
Spain	4.0	47.1	8.4
Sweden	5.72	71.6	7.9

1. OECD Employment Outlook 1994. Table 1.8.2 (active and passive measures).
2. 1993-1994 fiscal year.
3. 1992-1993 fiscal year.
4. 1992.
5. 1991.
Source: OECD Secretariat.

in Chouraqui et *al. (op. cit.).* For corporate taxes, these average 3.0 on a GDP-weighted basis, whilst a unit elasticity is assumed for indirect taxes.

Expenditure elasticities are derived for each country, based on the estimates of elasticity of the unemployment rate with respect to output (the reciprocal of the Okun coefficient), multiplied by the elasticity of unemployment benefits with respect to unemployment. This provides an estimate of the elasticity of unemployment benefits with respect to output, which is then applied according to its share of all current expenditures as shown in Table 4. Even with significant increases in unemployment, these expenditures remain a small part of total government expenditures, as shown in Table 5.

Structural budget balances: results

The resulting estimates of adjusted budget balances are presented in Table 6 and Figure 2; estimates of the cyclical components of budget balances reported in Table 7.

Table 6. **Comparison of actual and structural budget balances**[1]

Surplus (+) or deficit (–) as a per cent of GDP[2]

	1987	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	Average 1987-1996
United States											
Actual	–2.5	–2.0	–1.5	–2.5	–3.2	–4.3	–3.4	–2.0	–1.8	–1.8	–2.5
Structural	–2.5	–2.6	–2.3	–3.1	–3.4	–3.8	–3.2	–2.3	–2.3	–2.3	–2.8
Japan											
Actual	0.5	1.5	2.5	2.9	3.0	1.8	–0.2	–2.0	–1.8	–1.8	0.6
Structural	2.2	2.0	2.4	2.1	1.9	1.0	–0.1	–1.0	–0.6	–0.7	0.9
Germany											
Actual	–1.9	–2.2	0.1	–2.0	–3.3	–2.9	–3.3	–2.7	–2.4	–1.8	–2.2
Structural	–0.9	–1.9	0.0	–3.2	–4.9	–4.3	–2.7	–2.1	–1.8	–1.5	–2.3
France											
Actual	–1.9	–1.7	–1.2	–1.6	–2.2	–3.9	–5.8	–5.7	–5.0	–4.0	–3.3
Structural	–0.7	–1.4	–1.8	–2.2	–2.1	–3.4	–3.8	–3.7	–3.5	–3.1	–2.6
Italy											
Actual	–11.0	–10.7	–9.9	–10.9	–10.2	–9.5	–9.6	–9.7	–9.1	–7.8	–9.8
Structural	–11.5	–11.8	–11.5	–12.4	–11.2	–9.8	–8.7	–8.9	–8.5	–7.5	–10.2
United Kingdom											
Actual	–1.4	1.0	*0.9*	–1.2	–2.7	–6.2	–7.7	–6.8	–4.7	–3.2	–3.2
Structural	–2.7	–1.4	–1.5	–2.5	–1.7	–3.7	–5.0	–4.7	–3.1	–2.0	–2.8
Canada											
Actual	–3.8	–2.5	–2.9	–4.1	–6.6	–7.1	–7.1	–6.2	–4.7	–3.5	–4.8
Structural	–5.1	–4.8	–5.0	–4.6	–4.6	–4.2	–4.5	–4.5	–3.7	–3.0	–4.4
Australia											
Actual	–0.1	1.2	1.2	0.5	–2.8	–3.9	–3.7	–4.0	–2.9	–1.8	–1.6
Structural	–0.3	0.8	0.4	0.2	–1.6	–2.2	–2.3	–3.2	–2.7	–2.0	–1.3
Austria											
Actual	–4.3	–3.0	–2.8	–2.1	–2.5	–2.0	–4.2	–4.2	–5.0	–4.5	–3.5
Structural	–2.0	–1.9	–2.5	–2.5	–2.8	–2.1	–3.0	–3.5	–4.7	–4.7	–3.0
Belgium											
Actual	–7.4	–6.6	–6.3	–5.4	–6.5	–6.7	–6.6	–5.3	–4.6	–4.1	–5.9
Structural	–5.8	–4.4	–6.7	–6.4	–7.5	–7.5	–5.2	–4.0	–3.8	–3.7	–5.7
Denmark											
Actual	2.4	0.6	–0.5	–1.5	–2.1	–2.6	–4.4	–4.2	–3.0	–2.2	–1.7
Structural	1.9	0.9	0.4	–0.2	–0.1	–0.3	–1.9	–3.0	–2.5	–2.1	–0.7
Finland											
Actual	1.1	4.1	6.3	5.4	–1.5	–5.8	**–7.1**	–4.6	–5.1	–3.3	–1.0
Structural	–0.8	0.7	1.2	0.7	–2.0	–3.7	–3.4	–1.7	–3.7	–2.6	–1.5
Greece											
Actual	–10.9	–12.4	–14.5	–13.9	–13.0	–11.8	–13.5	–13.1	–11.6	–10.1	–12.5
Structural	–9.0	–11.9	–15.0	–13.2	–13.1	–11.7	–12.5	–11.8	–10.4	–9.3	–11.8

Table *6.* **Comparison of actual and structural budget balances**[1] *(cont'd)*

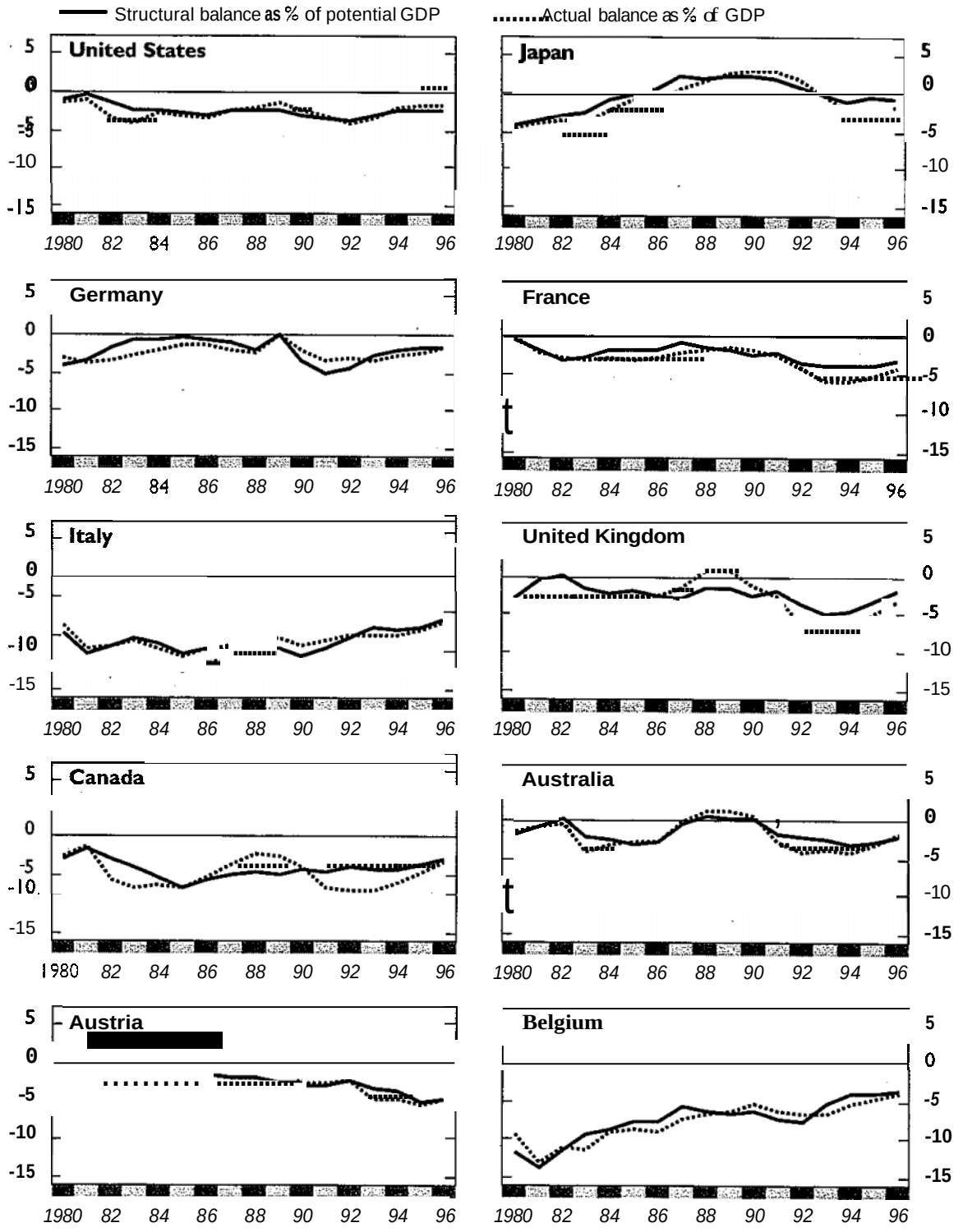
Surplus (+) or deficit (–) as a per cent of GDP[2]

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	Average 1987-1996
Ireland											
Actual	–8.5	–4.5	–1.7	–2.2	–2.1	–2.2	–2.4	–2.3	–2.0	–2.0	–3.0
Structural	-6.3	–2.5	–0.9	–2.9	–2.0	–2.3	–2.3	–2.2	–2.3	–2.5	–2.6
Netherlands											
Actual	–5.1	–4.2	–4.7	–5.1	–2.8	–3.8	–3.3	–3.8	–3.6	–2.9	–3.9
Structural	–2.6	–1.8	–3.9	–5.5	–3.0	–3.4	–1.6	–2.3	–2.6	–2.4	–2.9
Norway (mainland)											
Actual	2.2	1.0	–3.0	–4.4	–7.7	–9.7	–10.4	–8.4	–7.2	–6.7	–5.4
Structural	–0.9	0.0	–1.8	–3.2	–5.2	–7.3	–8.3	–6.9	–6.3	–6.1	–4.6
Portugal											
Actual	–7.3	–5.4	–3.1	–5.4	–6.1	–3.8	–8.0	–7.1	–6.6	–5.5	–5.8
Structural	–6.3	–4.9	–3.4	-6.7	–7.4	–4.5	–6.9	–5.2	–4.6	–3.7	–5.3
Spain											
Actual	–3.1	–3.3	–2.8	–4.1	–4.9	–4.2	–7.5	–6.8	–6.1	–5.2	–4.8
Structural	–2.6	–3.9	–4.3	–5.9	–6.2	–4.2	–5.5	–4.7	–4.0	–3.5	–4.5
Sweden											
Actual	4.2	3.5	5.4	4.2	–1.1	–7.4	–13.5	–11.2	–10.2	–9.7	–3.6
Structural	2.0	0.9	2.6	0.8	–2.6	–6.4	–9.9	–8.5	–8.2	–8.4	–3.8

1. Estimates for 1994 to 1996 are based on the economic projections reported in OECD Economic *Outlook.* No. 56. December 1994.
2. Structural balances are expressed as a per cent of potential GDP.

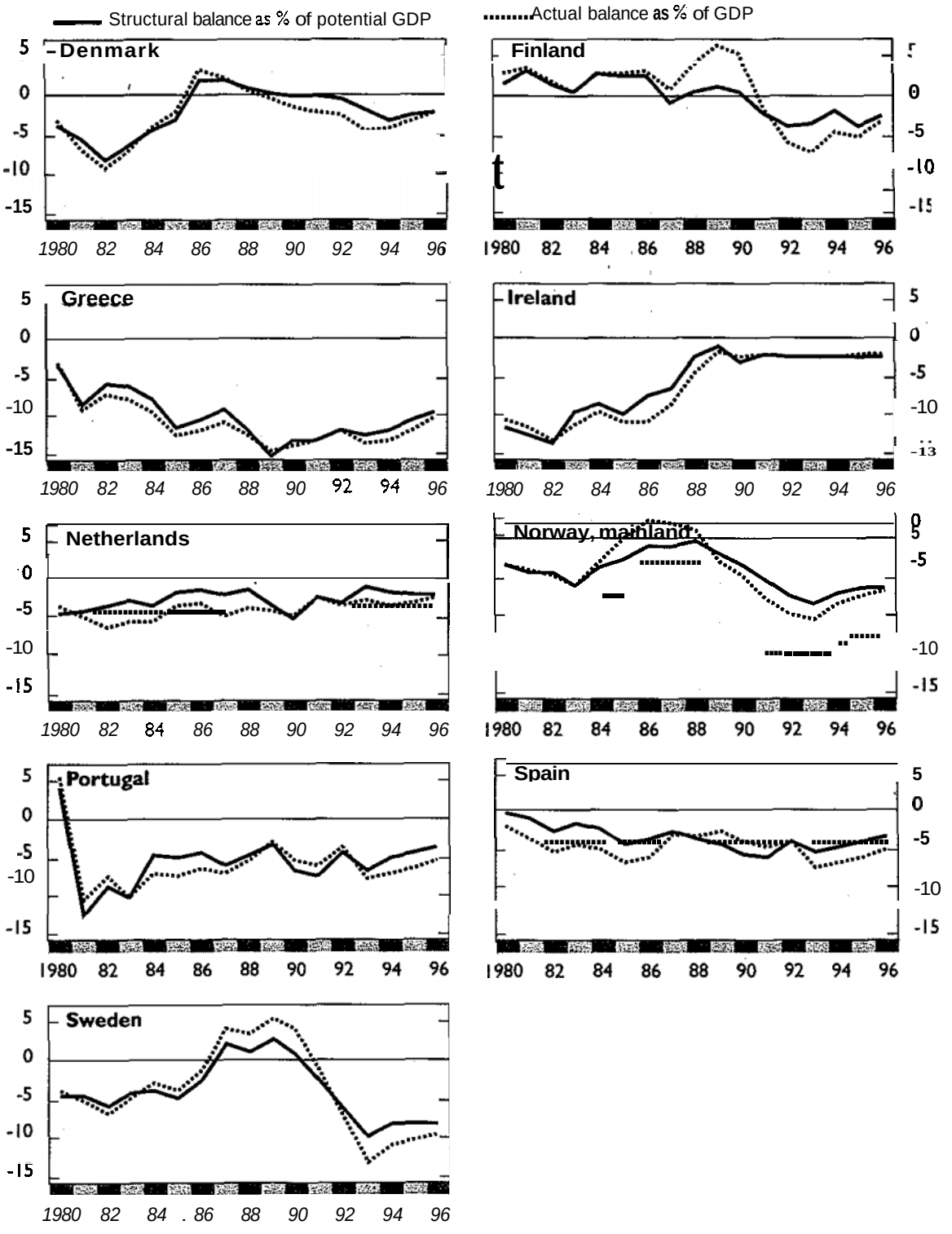
Source: OECD Secretariat.

Figure 2. ***General government balances***



Source: OECD. Economic *Outlook* 56, December 1994.

Figure 2. (con't.) **General government balances**



Source: OECD, Economic Outlook 56, December 1994

Table 7. Cyclical component of budget balances[1]

Surplus (+) or deficit (–) as a percentage of potential GDP

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	Estimates and projections 1994	1995	1996
United States2	0.9	–0.2	–0.5	–2.0	–1.5	–0.4	–0.2	–0.2	0.0	0.6	0.8	0.6	0.2	–0.5	–0.2	0.3	0.6	0.4
Japan[3]	0.0	–0.2	–0.3	–0.6	–1.2	–1.1	–0.9	–1.7	–1.8	–0.6	0.1	0.8	1.2	0.9	–0.1	–1.0	**–1.2**	–1.1
Germany[3]	1.8	1.0	**–0.2**	**– 17**	– 17	–1.2	–1.0	–0.7	–0.9	–0.3	0.1	1.1	1.5	1.3	–0.6	–0.6	–0.6	–0.2
France	0.9	0.4	–0.4	0.3	–0.4	–1.0	–1.2	–1.1	–1.2	–0.3	0.5	0.6	–0.1	–0.5	–1.8	–1.8	–1.4	–0.9
Italy	0.4	0.8	0.5	0.0	-O 3	–0.3	–0.2	0.0	0.4	0.7	1.1	1.0	0.7	0.2	–0.7	–0.6	–0.4	–0.2
United Kingdom	1.1	–0.5	–2.2	–2.6	–1.8	–1.6	–0.9	0.1	1.3	2.5	2.4	1.3	–0.9	–2.2	–2.3	–1.9	–1.5	–1.2
Canada	1.1	0.2	0.2	–2.6	–2.5	–1.0	0.1	0.5	1.2	2.2	*2.0*	0.5	–1.8	–2.5	–2.3	–1.5	–0.9	–0.4
Total of above countries	0.8	0.1	–0.5	**–1.4**	–1.4	–0.8	–0.5	–0.5	–0.3	0.4	0.8	0.8	0.4	–0.2	–0.6	–0.5	–0.3	–0.2
Australia	0.3	0.2	0.2	–0.8	–1.7	–0.5	**0.2**	–0.2	0.2	0.5	0.8	**0.4**	–1.1	–1.6	–1.3	–0.7	**–0.2**	0.2
Austria	0.9	**0.9**	–0.6	–1.3	**–1.4**	–1.9	–1.7	**–2.0**	–2.1	–1.1	–0.3	0.4	0.3	0.1	–1.1	–0.8	–0.5	–0.1
Belgium'	0.5	2.0	0.7	0.4	–1.7	–0.4	–0.9	–1.3	–1.5	–0.2	0.4	0.9	0.9	0.8	–1.2	–1.1	–0.7	–0.4
Denmark	1.6	0.4	–1.2	–0.9	–0.7	0.2	1.1	1.6	0.5	–0.3	–0.9	–1.3	–1.9	*–2.2*	–2.3	–1.2	-0.5	–0.1
Finland	0.5	1.2	0.3	0.3	0.1	0.2	0.5	0.8	1.9	**3.8**	6.0	5.3	0.5	–1.9	–3.3	–2.6	–1.2	–0.7
Greece	0.8	0.4	–0.3	–0.9	–1.3	–1.1	–0.7	–0.9	–1.5	–0.4	0.4	–0.5	0.1	–0.1	–0.7	–0.9	–0.9	–0.7
Ireland	0.9	0.7	0.7	0.2	**–1.4**	–0.8	–0.7	–2.9	–1.9	–1.8	–0.7	0.8	–0.1	0.1	–0.1	0.0	0.3	0.4
Netherlands	**1.7**	1.0	–0.6	–2.5	–2.6	–1.9	–1.7	–1.5	–2.3	–2.2	–0.7	0.4	0.2	–0.4	–1.5	**–1.4**	–1.0	–0.5
Norway[5]	–0.2	0.1	0.1	–0.4	–0.2	0.6	*2.9*	3.7	3.2	1.0	–1.1	–1.2	–2.3	–2.1	–1.8	–1.4	–0.9	–0.6
Portugal	0.9	1.7	1.4	1.1	0.0	–1.8	–2.1	–1.7	–0.9	–0.5	0.3	1.1	1.2	0.6	–0.9	–1.7	–1.8	–1.6
Spain	–1.2	–1.6	**–2.4**	–2.5	–2.5	–2.6	–2.3	–1.9	–0.5	0.6	1.5	1.7	**1.2**	0.0	–1.8	–2.0	–1.9	–1.6
Sweden	1.0	0.6	–0.4	–0.8	–0.8	0.9	1.1	1.5	2.3	2.7	3.0	3.6	1.4	–0.9	–3.0	–2.3	–1.8	–1.1
Total of above smaller countries	0.3	0.2	–0.7	–1.2	–1.6	–1.2	–0.9	–0.8	–0.4	0.1	0.8	1.1	0.3	–0.5	–1.6	**–1.4**	–1.1	–0.7
Total of above European countries	0.9	0.4	–0.6	–1.1	–1.3	–1.1	–0.9	–0.6	–0.3	0.4	0.9	1.1	0.5	–0.2	–1.4	**–1.3**	–1.0	–0.7
Total of above OECD countries	0.8	0.1	–0.5	–1.4	–1.4	–0.8	–0.6	–0.5	–0.3	0.4	0.8	0.8	0.4	–0.2	–0.8	–0.6	–0.4	–0.3

1. OECD Secretariat estimates **of** the cyclical component of general government financial balances corresponding to the *OECD* Economic Outlook. No. 56.
2. Excludes deposit insurance outlays. Receipts relating to Operation Desert Storm, amounting **to** 0.6 per cent **of** GDP in 1991. are excluded.
3. Excludes expenditure related to Operation Desert Storm in 1991 amounting to 0.2 percent of GDP for lapan and to 0.4 per cent **of** GDP for Germany.
4. Includes proceeds **of** privatisations and sales **of** other assets (**BF** 32.2 billion in 1993. **BF** 57 billion in 1994 and **BF** 13.5 billion in 1995).
5. As a percentage **of** mainland GDP. The financial balances shown exclude revenues from oil production.

Source: OECD Secretariat.

The tendency in most countries for the actual budget balance to fluctuate pro-cyclically around the estimated structural deficit is illustrated in Figure 2. Thus actual deficits grew strongly during the recession of the early 1980s, fell steadily in the mid- to late-1980s and rose again in the recent recession, relative to estimated structural deficits. For a number of countries, estimated structural deficits have been relatively stable over the past decade, fluctuating by no more than one or two per cent of GDP. In some cases, notably for Belgium, Denmark, Ireland, Portugal and Japan, estimated structural deficits fell steadily through the 1980s. For others, notably France, Greece, Norway, Finland and Spain, there is some trend deterioration over the period

With very few exceptions structural budget deficits widened significantly towards the end of the 1980s and in the early 1990s – most notably in Sweden. Norway, Finland, France and the United Kingdom. By 1994, the estimated average structural deficit for the OECD area was just over 3 per cent of potential GDP, with only six countries – the United States, Japan, Germany, Finland, Ireland and the Netherlands – having estimated structural deficits significantly less than 3 per cent of potential GDP. For other European countries – France, the United Kingdom, Austria, Belgium, Denmark and Spain have estimated deficits ranging from 3 to 5 per cent of potential GDP; Norway[14] and Portugal have estimated structural deficits between 5 and 8 per cent of potential GDP; and Italy, Greece and Sweden all have estimated structural deficits that are larger still. Among non-European countries, estimates for both Canada and Australia lie within the range of 3 to 5 per cent of potential GDP. Beyond 1994, recent OECD Secretariat's projections, reflecting the current fiscal plans of OECD governments, suggest modest falls in structural deficits for some countries but little movement or even a widening for others

NOTES

1. Recent OECD work on the links between demand pressure and price and wage inflation is summarised by Elmeskov (1993), Turner et *al.* (1993), Turner *et al.* (forthcoming) and Turner (in this journal).

2. As the change in the structural deficit is only a very rough indicator of discretionary policy, other indicators have been suggested to measure fiscal stance (see Blanchard, 1990).

3. Detailed background to previous OECD Secretariat work on fiscal indicators is given by Price and Muller (1984) and Chouraqui et *al.* (1990).

4. A number of other possible approaches are summarised in Canova (1993) and Nicoletti and Reichlin (1993).

5. Specifically, the variance of trend output falls as λ increases, whilst the amplitude of the corresponding output gap increases with λ.

6. Problems arising from the indiscriminate use of 1 600 for GDP and other data series are discussed in Canova (1993).

7. Later, Prescott and Kydland (1990) justified their choice of λ as producing a trend that most closely corresponded to the line that students would fit through GDP by hand and eye.

8. In the present study a value of $\lambda = 25$ was used for most OECD Member countries.

9. The medium-term projections used in the present study are those summarised in "Medium-Term Developments in OECD countries", *OECD Economic* Outlook No. 56 (1994).

10. To the extent that wage inflation is affected, not only by the level of unemployment but also its year-to-year changes, the derived short-run indicator will tend to move with actual unemployment and may thus differ from the long-run NAWRU obtained for a constant rate of unemployment.

11. Since the HP filter is applied to lnGDP, the resulting output gaps calculated from GDP and trend GDP are not exactly symmetric. The asymmetry grows as λ rises, but for the chosen values of λ presented here, it is negligible.

12. As noted by Turner (*op. cit.*), the imposition of exact symmetry in the cycle is, for some countries, inconsistent with the evidence on the influence of output gaps on inflation.

13. For Japan, the most notable differences reflect changes in working hours; for Norway and Finland fluctuations in the capital stock; for Spain and Austria, fluctuations in the labour supply.

14. For Norway, the structural deficit discussed here is measured excluding oil-related revenues and relative to the mainland GDP. On a whole-economy basis, the actual deficit is less than 3 per cent of GDP.

Annex

DETERMINATION OF INCOME-TAX AND SOCIAL SECURITY CONTRIBUTIONS ELASTICITIES

This annex sets out the method used to estimate the output elasticities for household-income tax and social security contributions referred to in Table 3 of the main text. The method involves a number of steps, which will be discussed subsequently below. First, the marginal and average tax rates (contribution rates) of a representative household at various points on the distribution of gross earnings are calculated. Second, these marginal and average tax rates (contribution rates) are weighted ,together using weights derived from an estimated income-distribution function. Finally, the output (GDP) elasticities of income taxes and social security contributions are derived, allowing for cross-country variation in the responsiveness of employment and wages to fluctuations in real output.

The results are subject to a number of limitations, reflecting a number of simplifying assumptions made. First, the representative household is taken to be one consisting of a full-time male worker, a working spouse with gross earnings equalling half of those of her husband, and two children. Second, the calculations refer to "production workers" only, and hence ignore the tax situation of, amongst others, the self-employed. Finally. the income-distribution functions are fitted on a limited number of observations (the first, fifth and ninth deciles), and are held constant over time.

The tax situation of individual households

The average and marginal tax rates at different levels of gross earnings depend on the specific features of the tax system, including tax credits, rebates, tax progression, tax ceilings and tax allowances for a dependent spouse and children, etc. The tax position of individual households on various points of the income distribution have been estimated on the basis of data compiled by the Directorate for Financial, Fiscal and Enterprise Affairs of the OECD Secretariat, modelling the tax systems in I5 individual countries, the major seven OECD countries plus Australia, Belgium, Denmark, Finland. Netherlands, Norway, Spain and Sweden. Simulations were carried out for 16 points on the distribution of gross earnings, with respect to both income tax and social security contributions, for the years 1978, 1981, 1985, 1989 and 1991, and, where data were available, also for 1992. Income tax comprises

local and central government taxes and social security contributions made by both employees and employers.

The "weighted average" tax situation

In order to calculate the .marginal and average rates for an "average" household, the distribution of gross earnings across households has to be estimated. For each country a log-normal income distribution function could be fitted, on the basis of two known parameters: the ratio of the income level at the first decile to the median income level and the ratio of the ninth decile to the median level (taken from the *OECD Employment Outlook 1993,* Table 5.2).

The weights required to calculate average and marginal tax rates, however, cannot be derived directly from the log-normal distribution function. What is needed is the frequency distribution of currency units earned – denoted as the "first-moment" distribution. It can be shown that the original distribution and the first-moment distribution have exactly the same standard deviation (σ), while the mean of the first-moment distribution exceeds that of the original distribution (u) by the variation coefficient (σ^2).

The weighted average earnings elasticities, finally, are calculated as follows (Table A1):

$$\varepsilon = \frac{\Sigma \gamma_i \frac{dt_i}{dy_i}}{\Sigma \gamma_i \frac{t_i}{Y_i}}$$

in which:

- ε = the earnings elasticity of income taxes or social security contributions;
- γ_i = the weight of earnings-level i in total earnings according to the first-moment distribution;
- t_i = income-tax payments (social security contributions) per household at earnings level i;
- y_i = earnings per household at earnings level i;
- dt_i/dy_i = the marginal tax rate (contribution rate) at point i on the earnings distribution;
- t_i/y_i = the average tax rate (contribution rate) at point i on the earnings distribution.

From earnings- to output-elasticities

Output growth will only be reflected to a limited extent in enhanced earnings and government revenues, as there are a number of "leakages" to be taken into account. First, output growth typically leads to a less than proportional increase in

Table A1. **Gross-earnings elasticities of income tax and social security contributions**

	1978	1981	1985	1989	1991	1992
	Income tax					
United States	2.5	2.3	2.1	3.2	3.4	3.9
Japan	2.7	2.9	2.9	2.6	2.6	..
Germany	1.8	1.a	1.a	1.9	2.0	..
France	2.9	3.0	3.0	3.0	3.0	..
Italy	1.a	1.9	1.4	2.3	1.a	..
United Kingdom	1.9	1.7	1.9	1.a	1.a	1.9
Canada	2.4	2.2	2.1	1.9	1.9	1.9
Australia	2.0	1.7	1.8	1.a	1.7	1.7
Belgium	3.6	2.0	1.9	2.3	2.2	..
Denmark	1.5	1.4	1.5	1.4	1.4	..
Finland	1.7	1.7	1.7	1.9	1.8	..
Netherlands	2.1	2.2	1.a	1.9	1.a	..
Norway	1.a	1.a	1.9	1.7	1.7	..
Spain	2.8	2.4	2.8	3.7	4.1	..
Sweden	1.6	1.5	1.4	1.4	1.3	..
	Social security contributions					
United States	0.8	1.0	1.0	1.0	1.0	1.0
Japan	1.0	1.0	1.0	1.0	1.0	..
Germany	0.9	0.9	0.9	0.9	0.9	..
France	0.8	0.8	0.9	0.9	0.9	..
Italy	1.0	1.0	1.0	1.0	1.0	..
United Kingdom	0.9	0.9	1.0	1.1	1.1	1.1
Canada	0.6	0.6	0.7	0.8	0.8	0.8
Australia	..	..	1.0	1.7	1.0	1.0
Belgium	0.9	1.0	1.0	1.0	1.0	..
Denmark	0.9	0.9	0.7	0.0	0.0	..
Finland	1.0	1.0	1.0	1.1	1.2	..
Netherlands	1.1	1.1	1.1	1.1	1.0	..
Norway	1.0	1.0	1.0	1.0	1.0	..
Spain	0.7	0.a	0.8	0.8	0.8	..
Sweden	1.0	1.0	1.0	1.0	1.0	..

Source: OECD Secretariat.

employment due to the presence of hoarded labour within firms. Second, a given rate of growth of employment typically produces a less than proportional increase in wages per household in as much as the number of households earning an income from employment also increases Third, and related to the second point, an increase in the number of wage earners, a *priori,* leads to a proportional rather than a progressive increase in payments to the government. If it is assumed that the newly employed are subject to the same distribution of earnings as the already employed, the appropriate elasticity of tax and social security contributions *vis-à-vis* employment is unity, and the following relationship will hold:

$$\alpha = EE(EW.\varepsilon + 1)$$
$$= EE.EW.\varepsilon + EE$$

Table A2. **Output elasticities of income tax and social security contributions in 1991**

	Earnings elasticity of		Output elasticity of employment	Employment elasticity of wages	Output elasticity of wages	Output elasticity of	
	Income tax	Social security contributions				Income tax	Social security
	(1)		(2)	(3)	(4) = (2) × (3)	(5) = (1) × (4) + (2)	
United States	3.4	1.0	0.64	0.26	0.17	1.2	0.8
Japan	2.6	1.0	0.19	2.00	0.38	1.2	0.6
Germany	2.0	0.9	0.45	0.57	0.26	1.0	0.7
France	3.0	0.9	0.38	0.90	0.34	1.4	0.7
Italy	1.8	1.0	0.15	0.74	0.11	0.3	0.3
United Kingdom	1.8	1.1	0.68	0.51	0.35	1.3	1.1
Canada	1.9	0.8	0.62	0.32	0.20	1.0	0.8
Australia	1.7	1.0	0.79	0.00	0.00	0.8	0.8
Belgium	2.2	1.0	0.49	0.63	0.31	1.2	0.8
Denmark	1.4	*0.0*	0.59	0.10	0.06	0.7	0.6
Finland	1.8	1.2	0.37	1.18	0.44	1.2	0.9
Netherlands	1.8	1.0	0.63	0.52	0.33	1.2	1.0
Norway	1.7	1.0	0.63	0.47	0.30	1.1	0.9
Spain	4.1	0.8	0.85	0.38	0.32	2.2	1.1
Sweden	1.3	1.0	0.50	1.33	0.67	1.3	1.2

Source: OECD Secretariat.

where: a = the output-elasticity of income taxes or social security contributions;
ε = the earnings elasticity of income taxes or social security contributions;
EE = the output-elasticity of employment;
EW = the employment-elasticity of wages.

i.e. the impact of a 1 per cent increase in output on tax proceeds is a composite of two factors: *i)* an increase in earnings per worker and the associated progressive increase in government proceeds; and *ii)* an increase in the number of workers in each earnings bracket and the associated proportional increase in government proceeds.

The calculations based on this relationship for 1991 are presented in Table A2 and the results for all years in Table **A3.** The output-elasticities of employ-

Table A3. **Output elasticities of income tax and social security contributions**

	1978	1981	1985	1989	1991	1992
	Income tax					
United States	1.1	1.0	1.0	1.2	1.2	1.3
Japan	1.2	1.3	1.3	1.2	1.2	..
Germany	0.9	0.9	0.9	0.9	1.0	..
France	1.4	1.4	1.4	1.4	1.4	..
Italy	0.4	0.4	0.3	0.4	0.3	..
United Kingdom	1.4	1.3	1.3	1.3	1.3	1.3
Canada	1.1	1.1	1.0	1.0	1.0	1.0
Australia	0.8	0.8	0.8	0.8	0.8	0.8
Belgium	1.6	1.1	1.1	1.2	1.2	..
Denmark	0.7	0.7	0.7	0.7	0.7	..
Finland	1.1	1.1	1.1	1.2	1.2	..
Netherlands	1.3	1.3	1.2	1.3	1.2	
Norway	1.2	1.2	1.2	1.1	1.1	
Spain	1.7	1.6	1.8	2.0	2.2	
Sweden	1.5	1.5	1.4	1.4	1.3	..
	Social Security contributions					
United States	0.8	0.8	0.8	0.8	0.8	0.8
Japan	0.6	0.6	0.6	0.6	0.6	..
Germany	0.7	0.7	0.7	0.7	0.7	..
France	0.7	0.7	0.7	0.7	0.7	..
Italy	0.3	0.3	0.3	0.3	0.3	..
United Kingdom	1.0	1.0	1.0	1.0	1.1	1.1
Canada	0.7	0.7	0.8	0.8	0.8	0.8
Australia		..	0.8	0.8	0.8	0.8
Belgium	0.8	0.8	0.8	0.8	0.8	..
Denmark	0.6	0.6	0.6	0.6	0.6	..
Finland	0.8	0.8	0.8	0.8	0.9	..
Netherlands	1.0	1.0	1.0	1.0	1.0	..
Norway	0.9	0.9	0.9	0.9	0.9	..
Spain	1.1	1.1	1.1	1.1	1.1	..
Sweden	1.2	1.2	1.2	1.2	1.2	..

Source: OECD Secretariat.

rnent and the employment-elasticities of wages have been taken from Elmeskov and Pichelmann (1993), with two exceptions. First, for Japan the employment-elasticity of wages has been set at 2, on the basis of simulations with the new version of the INTERLINK supply block, which accounts for the high responsiveness of overtime (and hence wages per household) to variations in activity (see Turner *et al.*, 1993, for a description of these simulations). Second, for Australia the employment elasticity of wages has been put at zero, which is probably more realistic than the negative value which is found on the basis of simple regression.

BIBLIOGRAPHY

BLANCHARD, O. (1990), "Suggestions for a new set of fiscal indicators", OECD Economics and Statistics Department Working Paper No. 79.

CANOVA, F. (1993), "Detrending and business cycle facts", CEPR Discussion Paper No. 782.

CHOURAQUI, J.C., R. HAGEMANN and N. SARTOR (1990), "Indicators of fiscal policy: a reexamination", OECD Economics and Statistics Department Working Paper No. 78.

ELMESKOV, J. and M. MACFARLAN (1993), "Unemployment persistence". OECD Economic Studies, No. 21 (Winter).

ELMESKOV, J. and K. PICHELMANN (1993), "Unemployment and Labour Force Participation – Trends and Cycles", OECD Economics Department Working Paper No. 130.

ELMESKOV, J. (1993), "High and persistent unemployment: assessment of the problem and its causes", OECD Economics Department Working Paper No. 132.

HODRICK, R. and E. PRESCOTT (1980), "Post-war US business cycles: an empirical investigation", Working Paper, Carnegie Mellon University.

KYDLAND, F. and C. PRESCOTT (1990), "Business cycles: real facts and a monetary myth", Federal Reserve Bank of Minneapolis, Quarterly Review (Spring), pp. 3-18.

NELSON, C. and C.I. PLOSSER (1982), "Trends and random walks in macroeconomic series", Journal of Monetary Economics 10, pp. 139-162.

OECD, Employment Outlook (1993) Paris.

OECD, Economic Outlook No. 56 (1994), Paris, December.

PRICE, W.R. and P. MULLER (1984), "Structural budget indicators and the interpretation of fiscal policy stance in OECD economies", OECD Economic Studies, No. 3, Autumn.

TORRES, R and J.P. MARTIN (1990), "Potential output in the seven major OECD countries", OECD Economic Studies No. 14, pp. 127-149.

TORRES, R, P. JARRETT and W. SUYKER (1989), "Modelling business sector supply for the smaller OECD countries", Economics and Statistics Department Working Paper No. 71.

TURNER, D. (1995), "Speed limit and asymmetric inflation effects from the output gap in the major seven economies", OECD Economic Studies No. 24, this issue.

TURNER, D., P. RICHARDSON and S. RAUFFET (1993), "The role of real and nominal rigidities in macroeconomic adjustment", OECD Economic Studies, No. 21, Winter.

TURNER, D., P. RICHARDSON and S. RAUFFET, "Modelling the supply side of the seven major OECD economies", OECD Economics Deportment Working Paper (forthcoming).