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Adjusting fiscal balances for the business cycle: New tax and expenditure elasticity estimates for OECD countries

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ADJUSTING FISCAL BALANCES FOR THE BUSINESS CYCLE: NEW TAX AND EXPENDITURE ELASTICITY ESTIMATES FOR OECD COUNTRIES

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By Robert W.R. Price, Thai-Thanh Dang and Jarmila Botev

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ABSTRACT/RÉSUMÉ

Adjusting fiscal balances for the business cycle: new tax and expenditure elasticity estimates for OECD countries

This paper re-estimates the elasticities of government revenue and expenditure items with respect to the output gap for OECD countries. These elasticities are used by the OECD to calculate cyclically adjusted fiscal balances. The study updates the earlier 2005 study using the most recent datasets and tax codes, the coverage being confined in this paper to 35 countries, the 34 OECD member states and Latvia. The same two-step methodology is retained: revenue and expenditure elasticities with respect to the output gap being defined as the product of, first, the elasticities of individual revenue and expenditure items with respect to their bases and, second, the elasticities of these bases with respect to the output gap. A number of refinements and methodological improvements are made relative to the 2005 study. The revisions to individual elasticities relative to the 2005 vintage are significant in a number of cases but do not follow a clear pattern across countries, except for the elasticities of corporate income tax revenue which are revised up in most cases.

JEL classification codes: E62, H30, H60.
Key words: budget elasticity, automatic stabilisers, fiscal surveillance, cyclically adjusted.

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Correction des soldes budgétaires en fonction des variations cycliques : nouvelles estimations d'élasticités des impôts et des dépenses pour les pays de l'OCDE

Cet article estime les élasticités des composantes de revenus et de dépenses des administrations publiques par rapport aux écarts de production pour les pays de l'OCDE. Ces élasticités sont utilisées par l'OCDE pour calculer les soldes financiers des administrations publiques corrigés du cycle économique. Cette étude est une mise à jour des travaux parus en 2005, elle utilise les données et les codes d'impôts les plus récentes , et couvre 35 pays, à savoir les 34 pays membres ainsi que la Lettonie. La méthode en deux étapes a été conservée : les élasticités par rapport aux écarts de production étant définies comme le produit , dans un premier temps, des élasticités des composantes individuelles de recettes et de dépenses par rapport à leurs assiettes , et dans un deuxième temps des élasticités de ces assiettes par rapport aux écarts de production. Des modifications et des améliorations méthodologiques ont été apportées depuis l'étude de 2005. Les révisions d'élasticités par rapport à la version de 2005 sont importantes dans certains cas mais ne suivent pas un schéma type pour tous les pays, à l'exception des élasticités des impôts sur les bénéfices des sociétés qui ont été révisées à la hausse dans la plupart des cas.

Classification JEL : E62, H30, H60.
Mots clefs : élasticité budgétaire, stabilisateurs automatiques, surveillance fiscale, ajustement cyclique.

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ADJUSTING FISCAL BALANCES FOR THE BUSINESS CYCLE: NEW TAX AND EXPENDITURE ELASTICITY ESTIMATES FOR OECD COUNTRIES

By Robert W.R. Price, Thai-Thanh Dang and Jarmila Botev[1]

I. Introduction

1. This paper presents new cyclically adjusted budget balance estimates for OECD member economies, based on revised and updated estimates of tax and expenditure elasticities. The existing elasticities date back to 2005, and relate to 2003 tax codes and tax base information (referred to as the 2005 model throughout this paper) (Girouard and André, 2005). The sample period used for all the regressions is 1990-2013.[2] The new elasticities incorporate information from the latest available tax and benefit codes (as of 2013, for most countries) and more up-to-date tax base information. The coverage is also extended to include the new OECD member states.[3,4] The paper is a sequel to the study on EU country elasticities published in December 2014 and used to update the European Commission's cyclical adjustment process (Mourre et al., 2014)[5], but is based on the output gap methodology used in the context of the OECD's forecasting exercise which does not coincide exactly with that of the European Commission (EC). As such, the results for EU economies will not exactly match those used by the Commission, but will essentially be very close.

2. The study broadly applies the same method as the 2005 one, which used tax code information to derive revenue to base elasticities and econometric analysis to derive the relationship between bases and the cycle. However, while the approach is broadly the same as in Girouard and André (2005), the paper introduces some refinements to the methodology in order to ensure that the cyclical adjustment model corresponds more closely to reality. The revisions are the following:

- In addition to making use of more informative and up-to-date income-distribution data, the calculation of aggregate personal income tax elasticities separately identifies the major tax base components of personal income: earned income, self-employment income and capital income. Previously, only taxes on wages were considered.

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1. Robert W.R. Price is a consultant economist, Thai-Thanh Dang is a consultant econometrician and Jarmila Botev is an economist with the OECD Economics Department. Corresponding author: Jarmila.Botev@oecd.org. The authors would like to thank Christophe André, Caterina Astarita, Sven Blondal, Yvan Guillemette, Annabelle Mourougane, Gilles Mourre, Thomas Neubig, Savina Princen, members of the Output Gap Working Group of the EU's Economic Policy Committee and delegates of the OECD Working Group on Short-Term Economic Prospects for comments and suggestions on earlier drafts; Sylvie Foucher-Hantala for statistical help; and Isabelle Fakih for help with document preparation.

2. For individual countries, the sample period may be shorter, due to data availability. For more detailed information on data sources and sample periods used for calculation of each elasticity, see the Appendix.

3. Latvia, which is in the process of accession, is also included.

4. OECD averages presented in the paper are computed using this extended set of countries. Nevertheless, the differences in average results for the extended set of countries and the country sample used in the 2005 are negligible.

5. This paper draws on a study which was originally commissioned by the European Commission to update the elasticities used to apply structural budget surveillance to EU member countries. The OECD report on EU elasticities was published in December 2014 (Price, Dang and Guillemette, 2014).

- The social security contribution elasticities take account of employer contributions as well as employee contributions.
- With respect to the elasticities of corporate income taxes and indirect taxes relative to their bases (profits and consumer spending respectively), the assumption that both have unit elasticities has been investigated empirically and the assumption of a unit elasticity for both taxes has been dropped in favour of regression-based elasticities. This contrasts with the Commission approach in which the indirect tax elasticities are assumed to be one.
- The links between non-tax revenues and the output gap have been investigated, but no significant relationship to the cycle has been found.
- In addition to re-estimating the links between unemployment–related transfers and the cycle, the relationship between other income related transfers (family benefits, housing benefits and in-work benefits) and the cycle has been examined. The inclusion of these transfers in the estimation process of the cyclically adjusted balance is a second source of difference between the OECD and the EC.
- With respect to the regression analysis of tax revenue to tax base elasticities and of tax base to output gap elasticities, the econometric approach has continued to be based on individual country regressions, rather than a pooled cross-section approach, largely because the characteristics of tax systems are so different internationally. However, the regression approach has been refined and re-specified to distinguish between short-term and long-term elasticities.

3. The paper is organised as follows. The next section gives an overview of the methodology which is elaborated further in the Annex. The third section computes the elasticities of government revenues and the fourth section the elasticities for government non-interest spending. The final section presents a measure of the overall sensitivity of the budget balance, with new cyclically-adjusted budget estimates.

II. Conceptual and methodological issues

4. The cyclically adjusted balance (CAB) measures the underlying fiscal position, removing the effects of the business cycle from the budget, the process of adjustment being applied in disaggregated form to the principal categories of revenues and to unemployment-related government spending in levels, such that:

$$b^* = [\sum_{i=1}^{n} T_i^* - G^* + X] / Y^* \tag{1}$$

where: b^* = cyclically adjusted fiscal balance as ratio of potential output; Y* = the level of potential output; T_i^* = the *i*th category of cyclically adjusted tax; G* = cyclically adjusted government current primary expenditures (i.e. government spending excluding capital and interest spending), and X = capital and net interest spending and non-tax revenue.[6]

6. This disaggregation of government spending into current and other spending is an OECD convention; it is not an essential part of the method. As will be seen below, the main issue is to identify those components of spending which are responsive to the cycle.

5. The adjustment is based on the elasticities of the respective tax categories, and of unemployment related spending, with respect to the output gap, so that:

$$b^* = \left[\sum_{i=1}^{n} T_i \, (Y^*/Y)^{\varepsilon_{ti.y}} - G(Y^*/Y)^{\varepsilon_{g,y}} + X \right] / Y^* \tag{2}$$

where: Y^*/Y= ratio of potential to the actual output (a measure of the output gap),T_i = actual revenue of the *i*th category of tax, G = actual government current primary expenditures, $\varepsilon_{ti,y}$ = the elasticity of the *i*th tax category with respect to the output gap and $\varepsilon_{g,y}$ = the elasticity of current primary government expenditures with respect to the output gap.

6. The OECD/EC method for calculating the elasticities uses a two-stage approach, which identifies separately *i)* the elasticity of revenues and expenditures with respect to their base ($\mathcal{E}_{t.tb}$), *ii)* the elasticity of bases with respect to the output gap ($\mathcal{E}_{tb.y}$):

$$\varepsilon_{ti,y} = \varepsilon_{ti,tbi} \, \varepsilon_{tbi,y} \quad and \quad \varepsilon_{g,y} = \varepsilon_{g,u} \, \varepsilon_{u,y} \tag{3}$$

The tax revenue to tax base elasticities, $(\varepsilon_{ti,tbi})$ depend on the relevant tax codes, while the elasticities of the tax bases with respect to Y*/Y $(\varepsilon_{tbi,y})$ are empirically estimated. Similarly, the government spending elasticities are composed of an elasticity of spending with respect to unemployment $(\varepsilon_{g,u})$ and an elasticity of unemployment with respect to Y*/Y $(\varepsilon_{u,y})$.

7. The 2005 model identifies four tax categories as being cyclically sensitive: direct taxes on households (personal income tax), social security contributions, corporate income tax and indirect taxes, the respective bases being taken as earnings (for income tax and contributions), the gross operating surplus for corporate income and consumption for indirect taxes. Only one category of spending is treated as cyclically sensitive – that relating to unemployment.

8. With respect to the calculation of the CAB, the OECD uses a disaggregated approach as per equation (2) : it first adjusts the individual tax and spending categories for the cycle, and then aggregates the resulting cyclically adjusted items, together with the non-tax revenue and capital and net interest spending, into a CAB. It is also possible to measure the responsiveness of the total budget balance-to-GDP ratio to the business cycle with a single number – the budgetary semi-elasticity. As opposed to an elasticity, which relates a percentage change of a tax (or spending) category in nominal terms to a percentage change in the output gap level, a semi-elasticity measures the absolute change of the budget balance-to-GDP ratio in response to a percentage change in GDP due to the business cycle. The budgetary semi-elasticity can be derived on a bottom-up basis from the individual tax and spending items, their output gap elasticities and relative weights.[7] The cyclical adjustment process of the EC applies this semi-elasticity directly to the budget balance to derive a CAB.

Scope for enhancement

Further disaggregation

9. The 2005 model is based on the national accounts (SNA) definitions and is fairly comprehensive in its coverage of revenues (Table 1). However, the level of aggregation involved leads to a considerable

7. For more details, see Section V below and Mourre et al. (2013).

degree of simplification with respect to the taxes identified in *OECD Revenue Statistics*, some elements of which offer the potential for improvements.

- The personal income tax (PIT) is related to wages and salaries in the 2005 model, whereas it is also levied on self-employment income, capital income, capital gains and (some) transfers, which may show a different cyclical behaviour from earnings. Realised capital gains are difficult to include in the cyclical adjustment process without specifying asset price cycles (Price and Dang, 2011). However, to the extent that capital income (interest, dividends etc.) is correlated with capital gains, some of the elasticity effects of asset prices movements are captured. Since some transfers are not taxed, the present study does not estimate separate elasticities for this income category.

- The cyclical adjustment process equates PIT to 'direct taxes on households', which according to National Accounts definitions also includes taxes on immovable property and net wealth. Wealth taxes are applied by only a small number of OECD economies. Property taxes are a more widely used source of revenue and may be related to the output cycle via new house building, as well as to asset-price cycles via house prices.[8] However, they only amount to 2.3% of total revenues on average (Table 1) so that the 2005 approach of not identifying separate elasticities for this tax category has been maintained.

- Indirect taxes (IT) are levied on a number of expenditure bases, including intermediate goods and some elements of investment – residential building and renovation – which may be more cyclically sensitive than consumption. These tax bases should, in principle, be unbundled from consumption[9]. Similarly, indirect taxes also include taxes on financial transactions, which are likely to exhibit a different degree of cyclicality from consumption.[10] However, the need to keep the updating exercise both uniform and tractable has prevented a move towards disaggregating indirect taxes, which continue to be related only to consumption.

- There is a category of revenues coming under the National Accounts rubric of 'capital taxes' levied on inheritances and gifts which is excluded from the adjustment process. While these taxes may be related to the business cycle indirectly, via asset prices, their weight is very small.

- Non-tax revenues have an important weight – about 20% of overall revenue on average - and the possibility that these may be cyclically related is examined here.

8. According to Price and Dang (2011), the relationship is not close, because of a lack of systematic revaluation in many countries.

9. They have been the origin of cyclical volatility in receipts not picked up in the existing adjustment method in the past.

10. OECD research shows that revenues in these categories are related to asset-price changes and not to GDP; though in some countries asset prices can be partially correlated to the business cycle, overall, the relationship is weak. For further analysis of these issues see Price and Dang (2011).

Table 1. Categorisation of taxes and transfers and their bases

National Accounts classification	SNA classification (SNA)	Base	Revenue Statistics (RS)	OECD weights % in total revenues/expenditures[1]
GOVERNMENT REVENUES				
1. Direct taxes on households				**24.2**
Taxes on personal income	D51	Earnings Transfers Self-employment income Income from capital Capital gains	1110 1120	21.5
Property taxes	D59	Property values	4100	2.3
Taxes on net wealth		Asset values	4200	0.4
2. Social security contributions				**19.8**
Employee contributions	D29	Wages and salaries	3000	7.4
Employer contributions				12.4
3. Corporate income taxes				**7.7**
	D51	Gross operating surplus and capital gains	1200	7.7
4. Indirect Taxes				**27.4**
Tax on general consumption	D21	Personal consumption	5000	26.2
of which VAT on new housing and repairs		Housing expenditure		
Taxes on specific goods and services		Personal consumption and intermediate goods		
Taxes on financial and capital transactions		Asset transactions	4400	1.2
5.Capital taxes				**0.3**
Estate, inheritance and gift taxes		Asset values	4300	0.3
6. Non-tax revenues				**20.6**
GOVERNMENT EXPENDITURES				
7. Government transfers				**8.4**
Unemployment-related spending		Unemployment		2.0
Income related and family benefits		Earnings		6.4

1. Shares are averages over the period 2001-2011 and unweighted averages of OECD member countries.

Source: OECD Revenue Statistics, OECD National Accounts Database, OECD Social Expenditures Database (SOCX).

Elasticity estimation processes

10. In the case of personal income taxes and social security contributions, the tax revenue to tax base elasticities are derived from the national tax codes, while in the case of corporate income taxes and indirect taxes the 2005 model assumes unit elasticity. Taxes with an elasticity of 1 – proportional taxes – do not affect the budget balance to GDP ratio, which means that, in effect, the principal drivers of cyclical variation in the budget balance to GDP ratio are personal income taxes and the social security contribution system. In the current analysis, the assumption that corporate income taxes and indirect taxes have unit elasticities was dropped in favour of empirically estimated elasticities. *A priori*, this allows for greater cyclical revenue sensitivity and greater cross-country variation in aggregate elasticities.

11. The regression modelling framework, which is described below, now also allows for the calculation of short-run and long-run tax revenue to tax base elasticities, which can diverge because of collection lags or compositional changes within the tax base. This specification would seem well adapted to account for the actual cyclical behaviour of indirect and corporate income taxes - the short-term elasticity capturing temporary movements due to cyclical shocks.[11] Reflecting institutional and behavioural differences, it is to be expected that the short-run elasticities will show greater international divergence than long-run elasticities. However, elasticities estimated in this way are also likely to be dependent on the time period involved and this poses problems for the cyclical adjustment process going forward, for instance where indirect taxes are subject to collection problems.

III. Revenue elasticities

1. Personal income taxes and social security contributions

Tax and social security contribution elasticities with respect to earnings

12. While in the 2005 model the elasticities of income tax referred to wage income, these were equated, in practice, with the elasticities of income tax relative to all incomes. Indeed, earnings (defined as wages and salaries) are the largest part of the PIT base and account on average for around two-thirds of the base. Earnings also constitute the base for social security contributions, which means that, on average for OECD economies, around two-fifths of general government revenues are based on earnings, making this tax base one of the most important drivers of cyclicality.

13. The elasticities of PIT revenues relative to earnings are derived from average earnings data, which relate per capita income tax paid to incomes along a distribution scale measured in multiples of average earnings. For individuals/households with identical characteristics as to marriage status and children, the average and marginal taxes can be calculated from the relevant tax codes at each point along the earnings schedule (see Annex Part I).[12] The aggregate average and marginal tax rates are then calculated by an income-weighting process, to provide the aggregate elasticity of tax relative to earnings $\varepsilon_{t,ye}$:

$$\varepsilon_{t,ye} = \frac{MR}{AR} = \sum \omega_{ye,i}\, mr_i / \sum \omega_{ye,i}\, ar_i \tag{4}$$

where $\omega_{ye,i}$ = the weight of percentile earnings-level *i* in total earnings expressed in currency units earned, mr_i = marginal income tax rate (social security contribution rate) at point *i* on the earnings distribution and ar_i = average income tax rate (social security contribution rate) at point *i* on the earnings distribution. *MR* and *AR* are the weighted marginal and average rates of tax, respectively. Both the definition of the 'representative' taxpayer and the income-weighting process used to generate the aggregate marginal and average rates are critical to the calculation process.

14. In the 2005 model, a log-normal distribution was fitted along an income distribution scale from zero to three times average earnings, to arrive at an aggregate elasticity for a representative average production worker, defined as a full-time two-earner married couple with two children.[13] The new calculations are based on an income scale which now covers zero to up to eight times average earnings and

11. See Belinga et al. (2014) for a similar approach.

12. The data refer to gross earnings of full-time workers by earnings percentiles in national currency units. The earnings by deciles are available from the *OECD Labour Market Statistics*.

13. The secondary earner is on 50 per cent of the average production worker earnings.

the parameters governing the log-normal distribution have been based on actual income distribution data.[14] To reduce the sensitivity of the results to the representative family type chosen, three household types have been averaged to produce the estimated PIT and employee social security contribution elasticities, rather than relying on a single family type.[15] The categories are i) single persons; ii) married couple with a single earner and no children; and iii) a married couple with two children, the second earner on two-thirds of average income. Data are not available as to the share of taxation paid by each family category, so they cannot be weighted to compute an average. An arithmetical average of the three types is used, as it is likely to be a more reliable estimate of the aggregate elasticity than applying the elasticity of a single component.

15. The elasticities of PIT revenue to earnings so calculated and the effects of applying the new parameterisation under the 2005 methodology are shown in Table 2 (see col. 2). The elasticities vary between 1¼ and 2¾. A prominent feature of the results is thus the rather wide dispersion of elasticities, around an OECD average of 1¾. These differences are explicable in terms of the varying tax structures in operation, ranging from a fairly flat and uniform structure (Denmark, Latvia) to one where allowances and exemptions determine that tax only starts to be paid well up the income scale. Higher thresholds tend to push up the aggregate tax elasticity for a given tax schedule (see discussion in Annex Part I).

16. Table 3 compares the new PIT elasticity estimates with those of the 2005 exercise, decomposing the changes into statutory and methodological changes.[16] The effect of statutory changes is reported in OECD (2012a)[17], while the impact of the methodology can be gauged by applying the 2005-model income distribution and representative-agent parameters to the 2010 data set (see Annex Part I). The overall impact of method and rate changes has been to increase the PIT-to-earnings elasticities for a half of OECD economies and reduce it for the other half. The revisions are in the range of + or – 0.6 (with the exception of Slovakia), though mostly of the order of + or – 0.2. The causes of the revisions are complex and discussed in greater detail in the Annex, but certain factors can be quantitatively identified:

- *Statutory changes* have had mixed effects.[18] In about a half of the economies covered by the 2005 study, the elasticity has declined, because of reduced thresholds or reduced tax progression. For the other half higher thresholds and/or more progressive rate structures (the former being more important) have pushed the elasticity up, though the effect is much more marginal.
- *Methodological change*: The broader definition of the representative family has had the effect of reducing elasticities, on average, because families with two children tend to have higher thresholds, which reduces the average rate of tax relative to the marginal and results in higher elasticities. Including families with no children hence reduces the aggregate elasticities. Changes in the income-weighting system (extending the analysis to higher income earners) have also had the effect of reducing income tax elasticities, on average, insofar as higher income earners face a lower tax elasticity and these are given a greater weight (see Annex Part I discussion). This would appear to be the case for Germany, Spain, Italy and Sweden, for example.

14. These income distribution data are available from the *Distribution and Poverty* data set which gives income and tax data by population decile; the standard deviation of income derived from this distribution is used to calculate the lognormal income distribution applied to the *Tax/benefits* data set (see Annex).

15. An exception is Italy, where taking account of the income tax structure, the average of two family types has been used: i.e. families with 0 and 2 children.

16. In some cases (Greece, Slovakia, for example) the 2005 exercise based the elasticity estimate on conventional assumptions rather than calculation.

17. Tax schedules are described for 2003 (the year used in the 2005 model calculations) and 2010, allowing the effects of statutory changes to be calculated between those two years.

18. Statutory effects have been estimated directly from the 2003 and 2010 income tax schedules given in OECD (2012a).

Table 2. Tax to tax base elasticities of income and social security contributions.

2005 and new methodology

	Tax elasticities relative to earnings							Tax elasticities relative to total personal income - SNA D51		
	Income tax		Social security contributions				Income tax and social security contributions	Income Tax		Income tax and social security contributions
	2005 estimates	New estimates	2005 estimates (employee)	New estimates (employee)	New estimates (employer)	New estimates (total)	New estimates	New estimates	Revision	New estimates
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Australia	1.50	1.62	0.00	0.00	0.00	0.00	1.62	1.60	0.10	1.60
Austria	2.20	2.00	1.00	0.85	0.99	0.92	1.25	1.97	-0.23	1.34
Belgium	1.60	1.63	1.10	1.30	1.00	1.15	1.34	1.62	0.02	1.36
Canada	1.60	2.06	0.80	0.70	0.71	0.71	1.42	2.04	0.44	1.65
Chile	..	2.76	..	1.00	0.00	1.00	1.47	2.16	..	1.14
Czech Republic	1.70	2.24	1.10	0.98	0.99	0.99	1.11	2.23	0.53	1.24
Denmark	1.40	1.44	1.00	0.70	0.00	0.70	1.23	1.43	0.03	1.38
Estonia	..	1.46	..	1.00	1.40	1.36	1.39	1.46	..	1.39
Finland	1.50	1.50	1.00	1.02	1.00	1.00	1.22	1.48	-0.02	1.25
France[1]	1.70	1.73	1.10	0.91	0.96	0.95	1.12	1.68	-0.02	1.20
Germany	2.30	1.90	0.80	0.76	0.97	0.86	1.13	1.88	-0.42	1.22
Greece	2.00	2.30	0.90	0.80	0.86	0.84	1.10	2.21	0.21	1.26
Hungary	2.43	1.84	0.90	1.00	0.99	0.99	1.21	1.80	-0.63	1.23
Iceland	1.44	1.73	1.00	1.25	1.00	1.05	1.42	1.72	0.28	1.58
Ireland	2.10	2.11	1.30	1.49	1.41	1.44	1.83	2.04	-0.06	1.82
Israel	..	1.94	..	1.37	1.16	1.23	1.54	1.83	..	1.51
Italy[2]	2.00	1.84	1.00	1.00	0.96	0.97	1.23	1.85	-0.15	1.39
Japan	2.00	1.88	0.90	0.89	0.88	0.88	1.13	1.87	-0.13	1.19
Korea	2.34	2.36	0.90	0.83	0.88	0.86	1.23	2.24	-0.10	1.42
Latvia	..	1.29	..	1.00	1.00	1.00	1.10	1.31	..	1.12
Luxembourg	2.50	2.28	1.30	0.90	0.93	0.91	1.22	2.24	-0.26	1.39
Mexico	..	2.22	..	1.11	1.06	1.07	1.32	2.08	..	1.72
Netherlands	2.40	2.15	0.80	0.84	0.71	0.80	1.35	2.00	-0.40	1.21
New Zealand	1.30	1.38	0.00	0.00	0.00	0.00	1.38	1.35	0.05	1.35
Norway	1.50	1.53	1.10	1.04	1.00	1.02	1.26	1.53	0.03	1.29
Poland	1.40	1.96	1.00	0.96	0.98	0.97	1.08	1.93	0.53	1.23
Portugal	1.70	2.22	1.00	1.00	1.00	1.00	1.24	2.15	0.45	1.40
Slovak Republic	1.00	2.47	1.00	0.97	0.98	0.98	1.10	2.43	1.43	1.26
Slovenia	..	2.15	..	1.00	1.00	1.00	1.21	2.14	..	1.34
Spain	2.10	1.93	0.80	0.88	0.82	0.83	1.13	1.88	-0.22	1.23
Sweden	1.30	1.45	1.00	0.69	1.00	0.95	1.16	1.42	0.12	1.26
Switzerland	1.84	1.92	1.20	0.79	0.87	0.83	1.05	1.87	0.03	1.47
Turkey	..	1.53	..	0.98	0.97	0.97	1.13	1.51	..	1.20
United Kingdom	1.70	1.50	1.30	0.97	1.33	1.20	1.35	1.49	-0.21	1.37
United States	1.90	1.65	0.90	0.93	0.79	0.85	1.20	1.64	-0.26	1.32
OECD	**1.80**	**1.88**	**0.90**	**0.91**	**0.87**	**0.92**	**1.27**	**1.83**	**0.04**	**1.35**

Note: This table compares tax-to-tax base elasticities between 2005 and new methodology. First, personal income tax elasticities now take account of self-employment and capital incomes in addition to earnings. Second, employers' social security contributions are also taken on board in the calculation of social security contributions (SSC) elasticities. Column 1 shows the PIT elasticities as derived in 2005. Compared to column 2, the differences reflect the changes in the tax system while applying the same methodology. However, compared to column 8, the differences reflect in addition the inclusion of other personal income components. Detailed calculations are shown in Table 4. Total revisions are indicated in column 9 and the sources of revisions are explained in Table 3.
Column 3 refers to the 2005 SSC elasticities and column 4 to the updates reflecting recent social security rates on the employees' side. Compared to column 6, the difference reflects the employers' contributions in the SSC elasticities. OECD averages are unweighted averages.

1. The published tax data have been adjusted to correspond to 2014 PIT tax schedule.
2. The elasticity is an average of married couple with 0 and 2 children, to take into account of the particular tax structure.

Source: OECD calculations, Taxing Wages (OECD 2012a), Girouard and André (2005).

Table 3. Source of revisions of tax to tax base elasticities for personal income and social security contributions

	Personal income tax elasticity					Social security contribution elasticity	
		Revision due to:				Revision due to:	
	Total revision	Policy	Methodology			Policy and methodology	Methodogy
		Statutory rate changes	Income distribution[1]	Representative type	Inclusion of non-earnings income	Employee contributions	Inclusion of employer's contributions[2]
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Australia	0.10	0.07	0.04	0.00	-0.02	0.00	0.00
Austria	-0.23	-0.05	-0.08	-0.07	-0.03	-0.15	0.07
Belgium	0.02	-0.03	0.03	0.03	-0.02	0.20	-0.15
Canada	0.44	0.19	0.31	-0.03	-0.03	-0.10	0.00
Chile	..	..	..	..	..	..	..
Czech Republic	0.53	-0.35	0.95	-0.06	-0.01	-0.12	0.00
Denmark	0.03	-0.03	0.05	0.02	-0.01	-0.30	0.00
Estonia	..	0.10	..	..	..	..	..
Finland	-0.02	-0.02	0.07	-0.05	-0.02	0.02	-0.01
France	-0.02	-0.29	0.32	0.00	-0.05	-0.19	0.04
Germany	-0.42	0.10	-0.51	0.01	-0.02	-0.04	0.10
Greece	0.21	-0.22	0.71	-0.19	-0.09	-0.10	0.04
Hungary	-0.63	-0.55	0.02	-0.07	-0.03	0.10	-0.01
Iceland	0.28	0.14	0.00	0.15	-0.01	0.25	-0.20
Ireland	-0.06	0.16	-0.01	-0.13	-0.07	0.19	-0.06
Israel	..	..	..	..	..	..	..
Italy	-0.15	0.05	-0.18	-0.03	0.01	0.00	-0.03
Japan	-0.13	-0.07	0.07	-0.12	-0.01	-0.01	0.00
Korea	-0.10	-0.63	0.85	-0.21	-0.12	-0.07	0.03
Latvia	..	..	..	..	..	..	..
Luxembourg	-0.26	-0.09	0.01	-0.15	-0.04	-0.40	0.01
Mexico	..	..	..	..	..	..	..
Netherlands	-0.40	-0.24	0.19	-0.20	-0.16	0.04	-0.04
New Zealand	0.05	0.13	-0.05	0.01	-0.03	0.00	0.00
Norway	0.03	0.03	-0.10	0.10	0.00	-0.06	-0.03
Poland	0.53	-0.43	1.75	-0.76	-0.03	-0.04	0.01
Portugal	0.45	0.00	1.03	-0.52	-0.06	0.00	0.00
Slovak Republic	1.43	0.21	1.20	0.06	-0.03	-0.03	0.00
Slovenia	..	..	..	..	..	..	..
Spain	-0.22	0.06	-0.17	-0.06	-0.05	0.08	-0.05
Sweden	0.12	0.44	-0.26	-0.02	-0.04	-0.31	0.26
Switzerland	0.03	0.02	0.24	-0.17	-0.05	-0.41	0.04
Turkey	..	..	..	..	..	..	..
United Kingdom	-0.21	0.03	-0.25	0.02	0.00	-0.33	0.23
United States	-0.26	0.04	-0.19	-0.10	-0.01	0.03	-0.08
OECD	**0.04**	**-0.04**	**0.22**	**-0.09**	**-0.04**	**-0.06**	**0.01**

Note: OECD averages are unweighted averages.

1. Includes the impact of new income distribution assumptions (see Annex) and other unidentified data-related factors.
2. Difference between column 6 and column 4 in Table 2.

Source: OECD calculations.

Taxes on other components of personal income

17. The 2005 model takes the personal income tax base solely as earnings, though, as noted, these are only one component of the base, which also includes self-employment income and capital income (Table 1). The tax revenues to tax base elasticities applying to these other components are likely to differ from that applying to earnings, but, more importantly, the relationship of the bases to the output gap is

likely to be quite different. In particular, for some countries, treating capital income as equivalent to earnings for cyclical adjustment purposes may have been a source of some error, because of the heightened cyclicality of dividends and capital gains. The estimation of aggregate PIT revenue elasticities with respect to total personal income and of total personal income with respect to the output gap thus requires the incorporation of the elasticities of capital and self-employment income into the cyclical adjustment process.

18. As is the case for earnings-related taxes, a two-stage approach has been adopted for the estimation of tax/output gap elasticities relating to non-earnings income components, as per equation 3. The tax/tax base elasticities applying to self-employment and capital income have been computed from cross-section income distribution data (the *Distribution and Poverty* data set). Separate tax/income elasticities can be inferred by applying the respective aggregate income weights to each average-income category, as in equation 4, except that the data exist only by decile and only in respect of the combined total of PIT plus employee social security contributions (for more details, see Annex). In general, taxes on capital income and self-employment income have lower elasticities with respect to their respective bases compared with those applying to earnings, driven by income distribution differences (Table 4, cols. 2-4). For OECD countries on average, the PIT/tax base elasticity remains unchanged compared to 2005, at 1.8 (Table 2 col. 8 and Table 4 col. 1).

Social security contributions

19. Employee social security contribution data are available in exactly the same form as personal income tax data in the Tax/benefits data set and an identical procedure has been applied to arrive at an elasticity of social contributions with respect to earnings, as in the previous model (Table 2, col. 4). In the 2005 model, the elasticities applying to employers' contributions, which are not covered by the average earnings data set, are assumed to be equal to those applying to employees' contributions. In fact, however, rates of employee and employer contributions usually differ and here the aggregate average and marginal rates of employers' contributions are calculated independently, and employers' contributions added to employee contributions at each point in the income distribution, *i*, based on the actual operational parameters of the contributions system. This allows the calculation of a *total* contributions/earnings elasticity according to equation 4 (Table 2, col. 6).

20. In aggregate, both employee and employer social security contributions increase less than proportionally to the *per capita* earnings base, since they are usually specified at a flat rate up to a statutory ceiling. Five OECD countries have unit elasticity, a quarter have progressive contributions and the remainder has regressive contributions. The reduced progressivity built into the system of social security contributions thus offsets to some extent the progressivity of the PIT, which ensures that the combined PIT and social security contributions elasticity is lower than the PIT elasticity in almost every case. The combined PIT and social security contribution elasticities range from 1.05 (Switzerland) to 1.8 (Ireland), with an OECD average of around 1¼ (Table 2, col. 7).

21. The sources of the revisions to social security contribution/earnings elasticities due to methodological and policy adjustments to employee contributions and to the inclusion of employer contributions are given in Table 3 (cols. 6 and 7). In general, the latter adjustments are small (col. 7), Iceland, Sweden and the United Kingdom being exceptions. Revisions to the employee contributions elasticity due to policy and methodology are somewhat larger (col. 6) and negative in several cases, and more marked in Switzerland, Luxembourg, the United Kingdom, Sweden, and Denmark, while the Belgian, Icelandic and Irish elasticities are relatively higher among those being revised up.

Table 4. Computation of tax to tax base elasticity of personal income and its components

	Personal income tax / tax base elasticity[1]	Direct tax / tax base elasticities of income components			Income component tax weights		
		Earnings[2]	Self-employment income	Capital income	Earnings	Self-employment incomes	Capital income
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Australia	1.60	1.62	1.47	1.51	0.74	0.06	0.10
Austria	1.97	2.00	1.85	1.70	0.61	0.10	0.04
Belgium	1.62	1.63	1.39	1.69	0.68	0.07	0.04
Canada	2.04	2.06	1.60	2.12	0.70	0.07	0.12
Chile	2.16	2.76	1.31	1.28	0.57	0.27	0.13
Czech Republic	2.23	2.24	2.24	1.77	0.63	0.14	0.02
Denmark	1.43	1.44	1.38	1.39	0.71	0.05	0.07
Estonia	1.46	1.46	1.45	1.46	0.76	0.02	0.01
Finland	1.48	1.50	1.43	1.32	0.65	0.06	0.05
France	1.68	1.73	1.69	1.38	0.58	0.06	0.10
Germany	1.88	1.90	1.87	1.74	0.57	0.17	0.06
Greece	2.21	2.30	2.14	1.59	0.49	0.22	0.05
Hungary	1.80	1.84	1.74	1.50	0.47	0.07	0.04
Iceland	1.72	1.73	1.44	1.67	0.74	0.02	0.07
Ireland	2.04	2.11	1.61	1.81	0.60	0.09	0.01
Israel	1.83	1.94	1.43	1.61	0.67	0.13	0.09
Italy	1.85	1.84	1.89	1.75	0.49	0.21	0.04
Japan	1.87	1.88	1.78	1.80	0.69	0.05	0.06
Korea	2.24	2.36	1.97	1.98	0.66	0.23	0.06
Latvia	1.31	1.29	1.24	1.60	0.65	0.10	0.06
Luxembourg	2.24	2.28	1.92	1.86	0.67	0.05	0.03
Mexico	2.08	2.22	1.45	1.64	0.73	0.12	0.06
Netherlands	2.00	2.15	1.84	1.20	0.67	0.08	0.11
New Zealand	1.35	1.38	1.30	1.23	0.65	0.10	0.12
Norway	1.53	1.53	1.54	1.52	0.67	0.05	0.08
Poland	1.93	1.96	1.84	1.51	0.64	0.12	0.02
Portugal	2.15	2.22	1.73	1.91	0.66	0.09	0.02
Slovak Republic	2.43	2.47	2.20	1.93	0.68	0.09	0.01
Slovenia	2.14	2.15	2.19	1.64	0.71	0.05	0.02
Spain	1.88	1.93	1.48	1.83	0.67	0.08	0.02
Sweden	1.42	1.45	1.21	1.17	0.68	0.03	0.08
Switzerland	1.87	1.92	1.46	1.80	0.72	0.07	0.10
Turkey	1.51	1.53	1.45	1.51	0.49	0.21	0.11
United Kingdom	1.49	1.50	1.49	1.48	0.67	0.08	0.09
United States	1.64	1.65	1.50	1.62	0.77	0.05	0.08
OECD	**1.83**	**1.88**	**1.64**	**1.61**	**0.65**	**0.10**	**0.06**

Note: OECD averages are unweighted averages.

1. See Table 2 column 8.
2. See Table 2 column 2.

Source: OECD calculations, see Methodological and Statistical Annex Table A1.2 for detailed explanations.

Table 5. Tax revenue to output gap elasticities of personal income and social security contributions

	Personal income tax / output gap elasticity[1]	Tax base to output gap elasticity[2]			Tax revenue to output gap elasticity			**Social security contribution / output gap elasticity[4]**	Social security contribution to earnings tax code[5]	Earnings to output gap elasticity[2]
		Earnings	Self-employment	Capital income	Earnings	Self-employment	Capital income[3]			
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Australia	2.25	1.03	1.29	4.57	1.67	1.90	6.91	0.00	0.00	1.03
Austria	1.81	0.77	0.96	3.81	1.55	1.78	6.46	0.71	0.92	0.77
Belgium	1.34	0.63	1.13	3.97	1.03	1.57	6.69	0.72	1.15	0.63
Canada	2.19	0.89	0.70	2.25	1.84	1.12	4.78	0.63	0.71	0.89
Chile	1.90	0.68	0.81	2.92	1.88	1.06	3.74	0.68	1.00	0.68
Czech Republic	2.13	0.84	1.35	2.03	1.88	3.03	3.59	0.83	0.99	0.84
Denmark	0.98	0.54	1.22	1.84	0.78	1.68	2.56	0.38	0.70	0.54
Estonia	1.56	1.03	0.92	3.54	1.50	1.33	5.16	1.39	1.36	1.03
Finland	1.36	0.70	1.22	3.70	1.04	1.75	4.89	0.70	1.00	0.70
France	1.85	0.73	1.33	3.52	1.27	2.24	4.86	0.70	0.95	0.73
Germany	1.86	0.61	1.97	1.82	1.15	3.69	3.17	0.52	0.86	0.61
Greece	2.00	0.66	1.14	3.02	1.52	2.43	4.80	0.55	0.84	0.66
Hungary	1.80	0.87	0.96	3.02	1.60	1.67	4.52	0.86	0.99	0.87
Iceland	1.81	0.88	1.12	3.02	1.52	1.62	5.05	0.92	1.05	0.88
Ireland	1.57	0.74	0.91	1.51	1.55	1.47	2.73	1.06	1.44	0.74
Israel	1.85	0.75	1.24	3.02	1.45	1.78	4.87	0.92	1.23	0.75
Italy	1.43	0.57	0.81	3.51	1.05	1.52	6.13	0.55	0.97	0.57
Japan	1.76	0.82	1.09	2.26	1.54	1.94	4.07	0.72	0.88	0.82
Korea	2.64	1.03	1.16	3.02	2.44	2.28	5.99	0.89	0.86	1.03
Latvia	1.32	0.73	1.28	3.02	0.94	1.59	4.83	0.73	1.00	0.73
Luxembourg	1.56	0.58	1.25	3.02	1.31	2.40	5.61	0.53	0.91	0.58
Mexico	1.91	0.75	1.24	3.02	1.66	1.79	4.95	0.80	1.07	0.75
Netherlands	1.94	0.71	1.93	2.58	1.54	3.55	3.09	0.57	0.80	0.71
New Zealand	1.23	0.64	1.45	2.02	0.88	1.88	2.49	0.00	0.00	0.64
Norway	1.63	0.84	1.06	3.02	1.28	1.63	4.58	0.85	1.02	0.84
Poland	1.87	0.95	0.80	3.02	1.87	1.47	4.58	0.92	0.97	0.95
Portugal	2.29	0.98	1.34	3.02	2.17	2.31	5.76	0.98	1.00	0.98
Slovak Republic	1.77	0.67	0.94	4.66	1.65	2.06	9.00	0.66	0.98	0.67
Slovenia	1.62	0.65	1.60	3.02	1.40	3.50	4.95	0.65	1.00	0.65
Spain	1.76	0.86	1.01	3.41	1.65	1.48	6.24	0.71	0.83	0.86
Sweden	1.43	0.77	1.06	3.39	1.12	1.29	3.96	0.73	0.95	0.77
Switzerland	1.93	0.69	0.86	3.91	1.32	1.25	7.03	0.57	0.83	0.69
Turkey	1.78	0.72	1.26	3.02	1.11	1.83	4.57	0.70	0.97	0.72
United Kingdom	1.71	0.61	2.97	3.39	0.91	4.42	5.03	0.73	1.20	0.61
United States	2.08	1.18	1.69	1.84	1.95	2.54	2.98	1.00	0.85	1.18
OECD	**1.77**	**0.77**	**1.23**	**3.02**	**1.46**	**2.02**	**4.87**	**0.71**	**0.92**	**0.77**

Note: OECD averages are unweighted averages.

1. Income component tax-weighted average (average of columns 5 to 7). See Annex A1.2 columns 9-12 for detailed explanations.
2. For earning and self-employment, output gap elasticities refer to adjusted elasticities. See Annex Table A1.10 for detailed calculations and Annex III for methodology.
3. See Annex Table A1.9 for detailed estimations of capital income to output gap elasticities.
4. Product of two following columns.
5. See Table 2 column 6.

Source: OECD calculations.

Output gap elasticities for personal income taxes and social security contributions

22. To obtain tax/output gap elasticities, the tax/tax base elasticities are combined with the tax base/output gap elasticities. The estimation of the latter elasticities follows the same procedure as the 2005 model, in regressing changes in the ratio of earnings to potential GDP on changes in the output gap. However, the econometric approach is based on an error correction method, which allows short-term elasticities to be identified more accurately (see Annex, part III). This procedure has also been adopted for self-employment income and capital income (see Table 5 cols. 3-4).

23. The elasticities of PIT and social security contributions relative to the output gap are shown in Table 5. The earnings/output gap elasticities average 0.8 for the OECD (col. 2), with a value of 1.2 for self-employment income (col. 3), though the latter has a greater dispersion. Capital income is generally significantly more responsive to the cycle, with an average elasticity of 3 (col. 4). Cross-country differences are fairly marked. The resultant PIT/output gap elasticities average 1.8 for the OECD (col. 1), which is somewhat higher than the 2005 model, largely on account of the greater cyclical sensitivity of capital income. Moreover, there are quite important revisions for individual countries.

2. Corporate income taxes

24. The 2005 model imposed a unitary elasticity of corporate income tax receipts with respect to the profits base, defined as the gross operating surplus: an assumption justified by the fact that the tax is usually imposed at a single statutory rate. However, while, in principle, the National Accounts record taxes on an accrual basis, *i.e.*, when the activities or transactions occur which create the liabilities to pay taxes, some flexibility is permitted when the liability to pay can only be determined in a later accounting period. This flexibility would seem to apply more to corporate income tax than any other tax. Moreover, past losses can be set against current profits and tax liabilities will be affected by capital gains, both of which will make the relationship between gross profits and taxes non-linear.[19],[20]

25. To assess the degree to which the short-term corporate tax elasticity can diverge from unity, in the current study corporate income tax/tax base elasticities have been estimated directly from time series data on corporate tax receipts and the gross operating surplus, which is taken as the most operational proxy for the corporate income tax base. The estimation procedure is based on an error-correction model (see Annex, part II), in which short-term elasticities are embedded within a lag structure which allows deviations from long-term trends to be gradually corrected. The selected estimation period is from 1990 to 2013 and a control for discretionary rate changes is introduced in the form of the statutory corporate tax

19. The non-symmetrical tax treatment of profits and losses (a firm pays taxes if it makes a profit, but it does not receive a refund for tax losses) and the provisions for carrying losses backward or forward into other tax years of most corporate tax systems cause difficulties in linking the tax base to current corporate income rendering the relationship between current corporate tax receipts and GDP potentially unstable.

20. There are other additional reasons which render the relationship between gross operating surplus and taxes non-linear: e.g. most tax systems have forms of accelerated capital cost allowances which differ from national income and financial statement depreciation allowances; many countries have lower corporate tax rates for smaller businesses; the tax schedules often have exemptions and tax credits, etc. Moreover, corporate income tax systems are usually based on net income and allow general deductions for interest expenses.

rate (Table A1.3). There are no controls to exclude the effects of other tax code changes[21] or asset price inflation, so that the tax elasticities could include the impact of coincident capital gains, as well as profits.[22]

26. The elasticity of corporate income tax relative to profits used for cyclical adjustment is calculated as a three-year average of short-term and long-term elasticities (see Annex, part II) and is 1.8 on average for the OECD area (Table 6, col. 2). Most of the elasticities are clustered in the 1½ to 2½ range, with the US elasticity being measured at 3½. Some dispersion is probably to be more expected than a uniform elasticity response.[23] Combining these tax elasticities with tax base/output gap elasticities which are generally above unity (col. 3), the average corporate tax elasticity is 2.1 for the OECD area (col. 1). This compares with 2005 estimates of 1.5 (col. 4). The major part of the revision is due to the new methodology used to generate the tax/tax base elasticities (col. 6). However, the new estimates for the tax base/output gap elasticities also have an impact. In the 2005 exercise, the elasticity of the profits base (gross operating surplus) to output was defined as the inverse of the wage/output gap elasticity; in the current exercise, the gross operating surplus/output gap elasticity has been estimated directly (Tables A1.8 and A1.10).

3. Indirect taxes

27. Indirect tax accounts for around 30% of OECD government revenues on average, of which around a half to two-thirds is accounted for by value added tax (VAT). Indirect tax is taken as proportional to its main tax base of consumption in the 2005 model and consumption is taken as proportional to the output gap. There are some grounds for questioning the empirical justification for a unit elasticity:

- VAT is not necessarily proportional if applied at different rates and if the higher rates are applied to more income elastic items: in that case the elasticity would be expected to be above unity. In fact, patterns of rates and exemptions differ substantially from country to country. This progressivity would matter if there were compositional shifts in consumption linked to the output gap, for which there appears to be some evidence (Sancak et al., 2010).[24]

- A further source of non-linearity and possible inter-country differences in indirect tax elasticities is the VAT treatment of residential housing, which is classified as investment or intermediate spending in the national accounts.[25] Around two-fifths of OECD countries exempt new building from VAT, or apply a zero rate, both of which rule out new building effects on the VAT/consumption elasticity. The remainder either impose VAT at the standard rate or at reduced rates, so that, depending on their amplitude and timing, cyclical movements in house-building can cause large swings in the VAT base as the output gap opens and closes. Year-to-year, VAT/consumption elasticities will reflect these swings.

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21. Other tax code changes are not included due to lack of data and may include, inter alia, changes to depreciation rules, tax credits or loss carryovers.

22. The elasticity results from earlier OECD research separating asset-price effects from profit-driven effects suggest that asset price movements may have significant cyclical effects on corporate income tax revenues in some countries (Price and Dang 2011).

23. The possibility of shifting profits from higher to lower taxed jurisdictions creates the potential for significant international variation in long-term elasticities; however, the short-term, cyclical effects of this are unclear.

24. In the case of the VAT, they find that a one percentage point increase in the output gap corresponds to a 1¼ percentage point increase in the 'efficiency' of this tax (across advanced and developing economies).

25. The purchase of dwellings (expenditure on dwellings by households), including reconstructions, renovations or enlargements and services relating to ownership transfer such as legal services, is considered as gross fixed capital formation in the national accounts.

Table 6. Corporate tax elasticities with respect to profits and the output gap

	Corporate tax / output gap elasticity	Elasticity of corporate tax relative to profit tax base[1]	Elasticity of profit tax base relative to output[2]	Corporate tax / output gap elasticity 2005 estimates	Total revision	due to : Corporate tax / tax base	due to : Tax base / output gap
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Australia	1.85	2.05	0.90	1.45	0.40	1.24	-0.84
Austria	2.61	1.98	1.32	1.69	0.92	1.47	-0.55
Belgium	2.61	1.76	1.48	1.57	1.03	1.16	-0.12
Canada	1.20	1.00	1.20	1.55	-0.35	0.01	-0.35
Chile	2.22	1.79	1.24	..	..	0.98	..
Czech Republic	1.28	1.23	1.04	1.39	-0.11	0.28	-0.39
Denmark	3.70	2.33	1.59	1.65	2.05	2.16	-0.11
Estonia[1]	1.76	1.79	0.98	..	..	0.78	..
Finland	2.80	2.12	1.32	1.64	1.15	1.66	-0.50
France	3.09	2.40	1.29	1.59	1.50	2.02	-0.52
Germany	1.97	1.51	1.31	1.53	0.43	0.72	-0.28
Greece[1]	2.08	1.79	1.17	1.08	1.00	0.88	0.12
Hungary[1]	2.06	1.79	1.15	1.44	0.62	1.02	-0.40
Iceland[1]	1.98	1.79	1.11	2.08	-0.10	1.25	-1.35
Ireland	0.89	0.71	1.25	1.30	-0.42	-0.37	-0.05
Israel[1]	2.19	1.79	1.23	..	..	..	..
Italy	2.61	1.73	1.51	1.12	1.49	0.96	0.53
Japan	2.17	1.79	1.22	1.65	0.52	1.13	-0.60
Korea[1]	1.63	1.79	0.91	1.52	0.11	0.96	-0.85
Latvia	1.78	1.89	0.94	..	..	..	..
Luxembourg[1]	2.21	1.79	1.24	1.75	0.46	1.17	-0.71
Mexico[1]	2.19	1.79	1.23	..	..	..	..
Netherlands	2.60	2.20	1.18	1.52	1.08	1.63	-0.55
New Zealand	2.38	1.88	1.27	1.37	1.01	1.16	-0.15
Norway	1.84	1.47	1.25	1.42	0.43	0.63	-0.21
Poland	2.02	1.73	1.16	1.39	0.63	0.94	-0.31
Portugal	1.43	1.54	0.92	1.17	0.26	0.57	-0.31
Slovak Republic	1.67	1.24	1.35	1.32	0.35	0.32	0.03
Slovenia[1]	2.34	1.79	1.31	..	..	..	..
Spain	2.11	1.77	1.19	1.15	0.96	0.90	0.06
Sweden	2.06	1.58	1.30	1.78	0.28	0.90	-0.62
Switzerland	1.80	1.14	1.58	1.78	0.01	0.23	-0.22
Turkey[1]	2.23	1.79	1.25	..	..	..	..
United Kingdom	2.71	2.36	1.15	1.66	1.05	1.91	-0.86
United States	1.95	3.45	0.56	1.53	0.41	2.56	-2.15
OECD	**2.11**	**1.79**	**1.20**	**1.50**	**0.61**	**1.04**	**-0.44**
OECD 2005 sample							

Note: OECD averages are unweighted averages.

1. Non-statistically significant estimates (NS) or missing values (NA) are set to the OECD average. See Annex Table A1.3 for detailed calculations.

2. Refers to adjusted elasticities. See Annex Table A1.10 and Annex for methodology.

Source: OECD calculations.

- A similar consideration emerges in relation to the taxation of financial transactions, which are included in the national accounts indirect tax aggregate (Table 1) but not in consumption. Indirect tax receipts may vary non-linearly when these items are cyclically sensitive and of a greater amplitude than consumption.
- The other principal components of indirect taxation, taxes on specific goods and services, would have an aggregate elasticity with respect to consumption which would be a function of the income elasticities of the various bases. Excises on fuel would have elasticity above one, as would some alcohol duties, while excises on tobacco would have a near zero income elasticity. Overall, these elasticities should probably not be assumed to sum to unity.

Panel data estimates carried out by the European Commission suggest a short term elasticity of around 1.2 to 1.3 for the EU, converging in around one year to a long term value lying between 1.0 and 1.1 (Princen and Mourre, 2014).

28. With the above considerations in mind, the possible biases involved in imposing indirect tax/consumption elasticities of unity have been assessed by separating VAT revenues (defined as category 5110[26] of *OECD Revenue Statistics*) from other indirect taxes and estimating VAT (or GST) elasticities from time series data. The regressions are again embedded in an error correction model, which separates short- from long-term responses (Annex, part II) and control for discretionary changes by including an index of policy-induced VAT changes. Such an index is available for EU countries in European Commission (2012) and has been estimated for non-EU countries by the OECD.

29. While there are reasons to think that this elasticity could actually depart from one and differ across countries, one of the most marked influences on the year-to-year changes in VAT has been shifts in VAT compliance. In particular, there is evidence to suggest that the VAT compliance gap, which measures the difference between the theoretical total VAT liability and actual cash receipts, was severely affected by the crisis in several countries, indicating a deterioration in tax compliance (European Commission, 2012 and Helgadottir et al., 2012). The VAT equations thus also control for shifts in compliance by incorporating the change in the 'VAT compliance gap' as a variable. This index is directly available for EU countries from European Commission (2012), but has actually been proxied for all OECD economies by the VAT Revenue Ratio (VRR) published by the OECD. This is a ratio of actual VAT revenue to VAT revenue measured by multiplying consumption by the standard rate of VAT and shifts in the ratio will arise out of changes in compliance. It should be noted that such a variable also controls for differences in VAT receipts caused by timing changes (i.e. by differences between cash receipts and accruals in the National Accounts).

30. The regressions deliver a set of VAT/GST elasticities with respect to consumption which average 1.2 for OECD economies and vary between 0.8 and 1.8 (Table 7). As explained in the Annex, the expedient adopted has been to take a 3-year average of the short-term and long-term elasticities, weighted according to the error-correction term. While the significant cross-country differences described above are difficult to trace back to differences in tax codes, the elasticity estimates are statistically robust and for the most part fit with historical perceptions of buoyant VAT yields during periods of cyclical boom. For other indirect taxes, the assumption of unit tax/consumption elasticity has been maintained, the composition of taxes being very complex and based heavily both on potentially cyclically buoyant excises (motor fuel) and on commodities with no clear relation to the cycle (alcohol duties). [27]

26. For estimation purposes, category 5110 ('general taxes') is used; this includes both VAT/GST (category 5111) and sales tax and is used to avoid discontinuities due to countries switching from sales taxes to VAT/GST

27. There is one exception: in the Italian case, the tax base for the IRAP (*Imposta regionale sulle attività produttive*) is classified as an 'other indirect tax'. This tax, instituted in 1997 is levied on companies exercising productive activities, and is applied to a tax base calculated from the value of net production

Table 7. Indirect tax elasticities with respect to the output gap

	Indirect tax/output gap elasticity[1]	Estimated VAT/GST tax to consumption elasticity	VAT/GST as % of total Indirect tax receipts	Applied other indirect tax / output gap elasticity
	[1]	[2]	[3]	[4]
Australia	0.97	0.90	27.5	1.00
Austria[2]	1.09	1.16	53.3	1.00
Belgium [2]	1.09	1.16	54.1	1.00
Canada	1.14	1.35	38.7	1.00
Chile	1.22	1.33	66.9	1.00
Czech Republic	1.06	1.10	59.4	1.00
Denmark	0.88	0.78	57.3	1.00
Estonia	1.22	1.35	64.5	1.00
Finland	0.96	0.94	60.8	1.00
France	0.91	0.81	48.1	1.00
Germany	0.95	0.92	61.7	1.00
Greece	1.04	1.06	56.3	1.00
Hungary	1.09	1.16	53.1	1.00
Iceland	1.07	1.13	56.5	1.00
Ireland	1.06	1.11	54.8	1.00
Israel	0.95	0.91	61.5	1.00
Italy [3]	1.10	1.11	42.2	1.10
Japan[2]	1.04	1.16	26.7	1.00
Korea	1.17	1.46	35.8	1.00
Latvia[2]	1.08	1.16	50.0	1.00
Luxembourg[2]	1.08	1.16	47.7	1.00
Mexico	1.10	1.17	62.4	1.00
Netherland	1.00	1.00	58.0	1.00
New Zealand	1.22	1.32	67.8	1.00
Norway[2]	1.08	1.16	49.8	1.00
Poland	0.98	0.96	44.1	1.00
Portugal	0.98	0.97	54.6	1.00
Slovak Republic	1.14	1.22	61.5	1.00
Slovenia	0.99	0.98	58.9	1.00
Spain	1.41	1.82	50.4	1.00
Sweden	1.19	1.49	37.9	1.00
Switzerland[2]	1.09	1.16	53.7	1.00
Turkey	1.10	1.45	22.3	1.00
United Kingdom	1.29	1.56	52.2	1.00
United States[4]	1.00	..	0.0	1.00
OECD	**1.08**	**1.16**	**50.0**	**1.00**

Note: OECD averages are unweighted averages.

1. Calculated as column 2 x column 3 + column 4 x (100% - column 3)
2. Not statistically significant estimates (NS) or missing values (NA) are set to the OECD average in column 2. See Annex table A1.4 for detailed calculations.
3. Exceptions apply to Italy, see explanations in the main text.
4. Not applicable to the United States.

Source: OECD calculations.

31. The assumption of a unit consumption/output gap elasticity has been maintained. As noted, the 2005 model assumed a consumption/output gap elasticity of unity on the grounds that there is no observable long-run equilibrium structure of demand which can be imputed to all countries at potential output. Regression analysis is not helpful here, since regressions relating consumption to Y*/Y would be inconsistent with the assumption of the cyclical adjustment process that government consumption and the

deriving from activity performed locally. It accounts for about two-thirds of 'other indirect taxes' and its base is broader than and different from consumption. Here the other indirect tax/consumption elasticity is set at 1.1.

capital stock are constant (the latter because the supply side is given). On the other hand, the consumption/output gap elasticity would differ from unity, and vary from country to country, according to whether demand is domestically or externally led (which would affect the indirect tax/output gap elasticity since exports are not taxed). This latter consideration is, however, a normative issue, and at least on average, there also seems to be some justification for continuing with the expedient of using unit consumption/output gap elasticity for cyclical adjustment purposes. This means that the indirect tax/output gap elasticity is equal to the indirect tax/consumption elasticity. The indirect tax/output gap elasticities calculated as a weighted average of VAT/GST elasticities and other indirect taxes average 1.1 for OECD economies, with a range of 0.9 to 1.4 (Table 7, col. 1).

4. Non-tax revenues

32. Non-tax revenues amount to around 8 per cent of GDP, or 20% of revenues on average (Table 1) and are not normally included in the cyclical adjustment process. The various components are likely to be affected in different ways by the cycle. Property income - dividends from state-owned companies and rents from government properties – could vary cyclically, but would be also subject to government policies on dividend reinvestment or on rents (Mourre et al., 2013). Important 'one-off' movements in receipts could arise from government taking over pension obligations from the private sector, which would involve a capital transfer to the government in return for it assuming future pension commitments. Other non-tax revenues could arise from intra-regional transfers, but their relation with the output gap is not clear cut. Against this background, it is unsurprising that regressions of non-tax revenue to output gap show that non tax revenues are not related to cycle (Annex Table A1.5).

IV. Government expenditure elasticities

1. Unemployment related spending

33. On the expenditure side, the elasticity of cyclically sensitive spending items can be estimated in the same way as taxation items, by separating the spending/output gap elasticity into two components: *i)* the elasticity of expenditures with respect to their base ($\mathcal{E}_{gi,gbi}$), and *ii)* the elasticity of bases with respect to output ($\mathcal{E}_{gbi,y}$).

$$\mathcal{E}_{gi,y} = \mathcal{E}_{gi,gbi}\, \mathcal{E}_{gbi,y} \tag{5}$$

where $\mathcal{E}_{gi,y}$ = the elasticity of the *i*th category of government spending relative to the output gap; $\mathcal{E}_{gi,gbi}$ is the elasticity of spending with respect to its base and $\mathcal{E}_{gbi,y}$ is the elasticity of the base with respect to output. In this case, the only items of spending that are involved in cyclical adjustment are transfers which respond to unemployment or income; the rest of the spending is taken as exogenous, as are interest payments on the national debt.

34. In the 2005 model the only element of spending defined as cyclically sensitive was unemployment-related spending. A unitary elasticity was assumed between unemployment-related expenditure and unemployment. The unemployment/output gap elasticity was empirically estimated and was thought of as a reduced form relationship, capturing variations in employment with respect to output and in the labour force with respect to employment.

35. Re-estimation yields output elasticities of unemployment-related expenditures close to the previous numbers on average, but with significant revisions for certain countries – most notably Ireland and Spain – largely because of the higher proportion of unemployment-related spending in total spending (Table 8). As with the 2005 model, a unit elasticity is assumed between unemployment-related expenditure and unemployment, which implies that the elasticity of unemployment spending with respect to the gap is the same as the unemployment/output gap elasticity. In high unemployment periods, there is reason to

believe that the composition effect would not be negligible, in particular for youth and low-skilled workers, who have accrued less rights and constitute a proportionally larger part of unemployment.[28] The elasticity of government current primary spending with respect to the output gap when only unemployment-related expenditure is considered to be cyclical, remains unchanged from the 2005 model, at -0.1.

2. Income-related benefits

36. Most other benefits, particularly where they are universal rather than means tested, will not be related to the cycle. However, certain benefits are related to income (family benefits, housing benefits, in-work-benefits) and these items of transfer spending need to be adjusted for the cycle. In fact, the same cross-section income/tax data set that allows the analysis of personal income taxes and social security contributions also provides information on these types of benefits, which can be translated into benefit/earnings elasticities per decile of average income in exactly the same way as personal income taxes and social security contributions. Making use of these data, estimates of the weighted elasticities of income-related benefits with respect to gross earnings, weighted in the same way as for income taxes and contributions, can be derived as follows:

$$\mathcal{E}_{ben.ye} = \Sigma\omega_{ye,i}\, mrb_i / \Sigma\omega_{ye,i}\, arb_i \tag{6}$$

where: $\mathcal{E}_{ben.ye}$ = the aggregate income-related benefit elasticity with respect to earnings (*ye*), mrb_i = the marginal rate of benefit at point *i* on the earnings distribution; arb_i = the average benefit/earnings ratio and $\omega_{ye,i}$ = the weight of earnings at income level *i* in total earnings.

37. The results are given in Table 8 (col. 7). Again, the range is quite wide, from around -0.5 to -1.7 for countries with a non-zero elasticity. The share of earnings-related benefits in government current primary spending is around 7% for the OECD area on average over the 2001-2011 period, ranging from 3.5% in Italy, and Japan to 12% and slightly over in Canada and the United Kingdom. When combined with the earnings/output gap elasticities described above, the elasticity of income-related benefits with respect to the output gap averages -0.6 (col. 9).[29]

38. The overall elasticity of government current primary spending with respect to the output gap rises from an average of -0.09 to -0.14 with inclusion of earnings-related benefits, the bulk of the sensitivity still deriving from unemployment-related spending. The range is quite wide: from near zero to -0.4.

28. The average of *estimated* unemployment benefit to unemployment rate elasticities is about 0.80, with country estimates mostly concentrated around 0.60, partly reflecting the compositional effect for some countries, while others are found to be close to unity.

29. By contrast to 2005 methodology the share of unemployment benefits to total current primary spending is averaged between 2001 and 2011, the latest year available in OECD Social Expenditure Database, in order to smooth large time variations in periods of unemployment crisis.

Table 8. Government expenditure elasticities

	Current primary expenditures/output gap elasticities[1] (unemployment related spending only)	Unemployment related transfers			Current primary expenditures/output gap elasticities[5] (unemployment related spending and social benefits related spending)	Earnings related social transfers			
		Share of unemployment related spending in total current primary expenditure (%)[2]	Output elasticity of unemployment[3]	Output elasticity of unemployment-related expenditure[4]		Share of earnings-related social benefits in total current primary expenditures[2]	Benefits-to-earnings elasticity	Earnings-to-output elasticity[6]	Elasticity of social benefits relative to output gap[7]
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Australia	-0.08	1.87	-4.39	-4.39	-0.19	10.49	-1.00	1.03	-1.03
Austria	-0.09	2.21	-4.01	-4.01	-0.13	6.74	-0.73	0.77	-0.57
Belgium	-0.30	7.27	-4.09	-4.09	-0.32	7.46	-0.56	0.63	-0.35
Canada	-0.10	2.03	-4.77	-4.77	-0.26	12.01	-1.50	0.89	-1.34
Chile[8]	-0.10	2.23	-4.41	-4.41	-0.10	7.27	0.00	0.68	0.00
Czech Republic	-0.06	1.63	-3.74	-3.74	-0.10	5.29	-0.95	0.84	-0.80
Denmark	-0.24	4.88	-4.91	-4.91	-0.31	10.43	-1.20	0.54	-0.65
Estonia	-0.03	0.76	-3.93	-3.93	-0.06	6.31	-0.53	1.03	-0.55
Finland	-0.12	3.87	-3.19	-3.19	-0.18	7.98	-1.02	0.70	-0.71
France	-0.07	3.14	-2.33	-2.33	-0.14	8.41	-1.02	0.73	-0.75
Germany	-0.11	3.58	-3.07	-3.07	-0.15	6.44	-0.92	0.61	-0.56
Greece	-0.03	1.30	-2.51	-2.51	-0.03	5.18	0.00	0.66	0.00
Hungary	-0.03	1.49	-2.12	-2.12	-0.10	9.08	-0.82	0.87	-0.71
Iceland	-0.12	1.63	-7.16	-7.16	-0.20	11.24	-0.85	0.88	-0.75
Ireland	-0.19	4.03	-4.67	-4.67	-0.19	11.55	0.00	0.74	0.00
Israel	-0.02	1.05	-2.13	-2.13	-0.07	8.80	-0.79	0.75	-0.59
Italy	-0.04	1.28	-2.91	-2.91	-0.04	3.46	0.00	0.57	0.00
Japan	-0.04	1.16	-3.14	-3.14	-0.07	3.49	-1.06	0.82	-0.87
Korea[9]	-0.05	0.93	-5.70	-5.70	-0.08	4.54	-0.53	1.03	-0.55
Latvia[10]	-0.08	1.85	-4.15	-4.15	-0.10	4.43	-0.67	0.73	-0.49
Luxembourg	-0.05	2.49	-2.00	-2.00	-0.12	11.58	-1.03	0.58	-0.59
Mexico[8]	-0.06	2.23	-2.69	-2.69	-0.06	7.27	0.00	0.75	0.00
Netherlands	-0.18	3.18	-5.70	-5.70	-0.22	6.62	-0.86	0.71	-0.61
New Zealand	-0.06	1.64	-3.37	-3.37	-0.18	11.12	-1.71	0.64	-1.09
Norway	-0.05	1.08	-4.47	-4.47	-0.11	9.14	-0.77	0.84	-0.64
Poland	-0.03	1.24	-2.48	-2.48	-0.07	3.58	-1.14	0.95	-1.09
Portugal	-0.12	2.58	-4.67	-4.67	-0.15	3.63	-0.70	0.98	-0.68
Slovak Republic	-0.02	1.11	-2.09	-2.09	-0.06	6.65	-0.76	0.67	-0.51
Slovenia	-0.04	1.29	-2.73	-2.73	-0.07	6.00	-0.93	0.65	-0.60
Spain	-0.42	6.26	-6.77	-6.77	-0.44	4.45	-0.51	0.86	-0.44
Sweden	-0.08	1.68	-4.52	-4.52	-0.16	8.76	-1.22	0.77	-0.94
Switzerland	-0.09	2.37	-3.91	-3.91	-0.13	6.33	-0.77	0.69	-0.53
Turkey[11]	-0.01	0.38	-2.28	-2.28	-0.01	1.55	0.00	0.72	0.00
United Kingdom	-0.03	0.78	-4.28	-4.28	-0.10	12.29	-0.93	0.61	-0.57
United States	-0.11	1.46	-7.65	-7.65	-0.18	4.83	-1.24	1.18	-1.47
OECD	**-0.09**	**2.23**	**-3.91**	**-3.91**	**-0.14**	**7.27**	**-0.76**	**0.77**	**-0.60**

Note: OECD averages are unweighted averages.

1. Weighted average, column 2 x column 4.
2. Unemployment and earnings-related benefits are taken from the OECD Social Expenditures Database (SOCX). They are expressed as a ratio to current primary expenditures, taken from the OECD National Accounts Database. An average of these ratios over the period 2001-2011 is reported in this table, the year 2011 being the latest available in the SOCX database for most countries.
3. Not statistically significant estimates (NS) or missing values (NA) for OECD are set to the OECD average for column 3. See Annex Table A1.11 for detailed estimates.
4. Output elasticities of unemployment related expenditures is equal to column 3 because of the assumption that the elasticity of unemployment benefits to the unemployment rate is one.
5. Weighted average, column 2 x column 4 + column 6 x column 9.
6. Refers to adjusted elasticities. See Annex Table A.1.10 and Annex for methodology.
7. Output elasticities of social benefits are derived as column 7 x column 8.
8. For Chile and Mexico, the OECD average was taken to weight both unemployment and earnings-related expenditure (columns 2 and 6), as the relevant data is not available for these countries.
9. Earnings-related benefits for Korea do not contain housing expenditure, as it is not available in SOCX.
10. Elasticity of benefits to earnings (column 7) for Latvia was estimated using Eurostat ESSPRO data, as no data on Latvia is available in the SOCX database.
11. The weights of unemployment-related benefits (column 2) and earnings-related benefits (column 6) for Turkey are based on the 2006-2011 period and Eurostat Social Expenditure data.

Source: OECD calculations.

V. Aggregate budget sensitivity and cyclically adjusted budget estimates

39. This section presents a measure of the overall sensitivity of the budget balance to the cycle, together with new cyclically-adjusted budget balance estimates for OECD economies. In the OECD cyclical adjustment process, the individual tax elasticities are applied to the relevant national accounts tax aggregates (Table 9) and the composite primary current expenditure elasticity (Table 8, col. 5) is applied to the appropriate expenditure aggregate, namely current spending net of interest payments. This means that the CAB is derived directly from the individual revenue and expenditure items, their elasticities and the output gap (as per equation 2 in section II). The overall responsiveness of the total budget balance to the cycle might thus vary over time, as the weights of the individual revenue and expenditure items in total balance and the share of total revenues and expenditures in GDP change over time. This approach contrasts with that used by the European Commission, which computes a budget balance semi-elasticity – a coefficient measuring the absolute change in the budget balance ratio relative to the percentage change in the output gap – from the weighted averages of the individual elasticities, using fixed weights, and applies this semi-elasticity to the output gap in order to arrive at the CAB (Mourre et al., 2014). Whilst the semi-elasticity concept is not directly used in the OECD adjustment process, it is, nevertheless, of strategic interest, being a measure of the overall built-in stability of the fiscal system, as well as being useful as an expositional device explaining the derivation of structural balances[30] from the tax and expenditures sides.

1. Sensitivity of the budget balance to the output gap

40. The budget balance semi-elasticity with respect to the output gap is defined as follows[31]:

$$b^* - b = -\epsilon \cdot (Y - Y^*)/Y^* = -\epsilon \cdot (GAP) \quad (7)$$

where the budget balance ratio is defined as $b = \frac{R}{Y} - \frac{G}{Y}$, R = total government revenues, G = total government expenditure and the aggregate semi-elasticity $\epsilon = db/(dY/Y)$ captures the absolute (first difference) reaction of the budget balance ratio to a percentage cyclical change in GDP (the output gap). The semi elasticity of the budget balance to GDP *ratio* is equal to the GDP-weighted average of the aggregate cyclical elasticity of total revenue ($\varepsilon_{r.y}$) minus 1 and the aggregate cyclical sensitivity of expenditure ($\varepsilon_{g.y}$) minus 1:

$$\epsilon = (\varepsilon_{r.y} - 1)({}^{R}/_{Y}) - (\varepsilon_{g.y} - 1)({}^{G}/_{Y}) \quad (8)$$

30. The term "structural balance" usually denotes the budget balance adjusted for both the business cycle and one-off factors and temporary policy measures. Since the analysis of one-off factors is beyond the scope of this paper, the term "structural balance" is used here as a synonym of CAB.

31. This formula is a linear approximation of the exponential expressions used in the first part of the paper: for more details and derivation see Mourre et al. (2013).

Table 9. Summary of revenue elasticities with respect to the output gap

	Individual revenue items to output gap elasticities				Shares of individual items in total government revenue 2002-2011, average % of total revenue				Total revenue elasticity (tax weighted average)
	Personal income tax[1]	Social security contributions[2]	Corporate income tax[3]	Indirect taxes[4]	Peronal income tax	Social security contributions	Corporate income tax	Indirect taxes	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Australia	2.25	0.00	1.85	0.97	34.46	0.00	15.05	34.93	1.39
Austria	1.81	0.71	2.61	1.09	22.25	30.89	4.57	29.34	1.06
Belgium	1.34	0.72	2.61	1.09	26.68	32.41	6.26	26.21	1.04
Canada	2.19	0.63	1.20	1.14	29.05	11.70	9.54	29.27	1.16
Chile	1.90	0.68	2.22	1.22	21.87	23.30	8.42	30.61	1.13
Czech Republic	2.13	0.83	1.28	1.06	10.43	37.95	9.90	27.46	0.95
Denmark	0.98	0.38	3.70	0.88	47.32	2.71	5.39	31.02	0.95
Estonia	1.56	1.39	1.76	1.22	15.87	29.62	3.45	34.33	1.14
Finland	1.36	0.70	2.80	0.96	25.52	22.59	6.41	25.17	0.93
France	1.85	0.70	3.09	0.91	17.47	35.80	5.07	30.10	1.00
Germany	1.86	0.52	1.97	0.95	19.20	39.24	6.11	24.57	0.92
Greece	2.00	0.55	2.08	1.04	12.37	31.82	8.91	31.02	0.93
Hungary	1.80	0.86	2.06	1.09	16.35	29.25	4.38	36.51	1.03
Iceland	1.81	0.92	1.98	1.07	33.84	7.46	5.99	37.55	1.20
Ireland	1.57	1.06	0.89	1.06	23.41	15.81	13.61	34.54	1.02
Israel	1.85	0.92	2.19	0.95	17.63	15.71	11.85	37.78	1.09
Italy	1.43	0.55	2.61	1.10	24.75	28.30	5.97	31.34	1.01
Japan	1.76	0.72	2.17	1.04	15.88	34.37	9.61	25.82	1.01
Korea	2.64	0.89	1.63	1.17	11.88	19.47	10.76	34.96	1.07
Latvia	1.32	0.73	1.78	1.08	17.31	25.43	5.30	37.60	0.92
Luxembourg	1.56	0.53	2.21	1.08	15.76	27.30	17.11	30.06	1.09
Mexico	1.91	0.80	2.19	1.10	21.87	8.41	8.42	24.72	0.94
Netherlands	1.94	0.57	2.60	1.00	17.76	32.00	7.31	27.06	0.99
New Zealand	1.23	0.00	2.38	1.22	35.27	2.88	12.76	30.46	1.11
Norway	1.63	0.85	1.84	1.08	18.70	16.41	18.27	21.55	1.01
Poland	1.87	0.92	2.02	0.98	12.10	32.15	5.65	34.70	0.98
Portugal	2.29	0.98	1.43	0.98	13.18	28.29	7.97	34.12	1.03
Slovak Republic	1.77	0.66	1.67	1.14	9.94	35.43	7.92	31.04	0.89
Slovenia	1.62	0.65	2.34	0.99	14.40	33.41	4.84	34.08	0.90
Spain	1.76	0.71	2.11	1.41	19.09	33.63	8.31	28.56	1.16
Sweden	1.43	0.73	2.06	1.19	30.42	7.40	5.17	41.40	1.09
Switzerland	1.93	0.57	1.80	1.09	31.69	19.79	10.24	19.32	1.12
Turkey	1.78	0.70	2.23	1.10	21.87	23.30	8.42	30.61	1.08
United Kingdom	1.71	0.73	2.71	1.29	31.15	20.31	8.07	31.26	1.30
United States	2.08	1.00	1.95	1.00	28.66	21.07	7.69	22.42	1.18
OECD	**1.77**	**0.71**	**2.11**	**1.08**	**21.9**	**23.3**	**8.4**	**30.6**	**1.05**

Note: Shares in totals and shares in GDP are an average of 2002-2011 or of available years within that period (Mexico and Luxembourg). Shares of Chile and Turkey were set to OECD average, due to missing data.
OECD averages are unweighted averages.

1. See Table 5 column 1.
2. See Table 5 column 10.
3. See Table 6 column 1.
4. See Table 7 column 1.

Source: OECD Economic Outlook 96 database and OECD calculations.

41. The total revenue elasticity ($\varepsilon_{r.y}$) is derived as a weighted average of the individual tax elasticities (Table 9), with a zero elasticity being applied implicitly to capital taxes and non-tax revenues: $\varepsilon_{r.y} = \sum_t \varepsilon_{t.y}\omega_{t.r}$ where $\omega_{t.r}$ is the weight of tax category *t* in total government revenue. The expenditure elasticity is derived by weighting the current primary expenditure elasticity by the share of current primary expenditure in total expenditure, with a zero elasticity being applied implicitly to other spending categories (debt interest payments and capital expenditures): $\varepsilon_{g.y} = \varepsilon_{pg.y}\omega_{pg.g}$ where $\omega_{pg.g}$ is the weight of government current primary expenditure in total government expenditure. The fact that, in practice, the OECD applies individual elasticities to separate tax bases and then aggregates up to the cyclically adjusted revenue measure means that the actual weights used vary in each period and the actual (implicit) semi-elasticity is time-varying. The budget balance semi-elasticities presented in Table 10 for indicative purposes are computed using average weights over the period 2001 to 2011. In the European Commission method the semi-elasticity is a constant as the weights are fixed and based on a similar historical average.

42. For OECD economies on average, the budget balance increases by 0.5 per cent of GDP for a 1 percentage point increase in the output gap, with a range of 0.21 – 0.66 per cent of GDP (Table 10). This compares with an average figure of 0.44 in the 2005 model[32]. For a sample of countries that are both OECD and EU members, and Latvia, the average semi-elasticity of 0.53 is only marginally higher than the EC estimate of 0.52. Nevertheless, since the OECD approach also allows for non-unitary indirect tax elasticities and for the cyclical sensitivity of income-related transfers, in addition to using different output gaps, the semi-elasticities for individual EU countries differ from EC estimates presented in Mourre et al. (2014)[33].

43. With an average total revenue to output gap elasticity only just above unity, the revenue side of the ledger has only a small, positive effect on the overall budget balance semi-elasticity (Table 10). The contribution of the expenditure side is the most important influence by far. The negative cyclical impact of expenditure on the budget balance includes not only the effects of lower unemployment- and earnings-related spending as the output gap closes, but also a denominator effect on the expenditure/GDP ratio due to other public spending being invariant to the cycle: the ratio of cyclically-insensitive expenditure to GDP ratio varies inversely with the gap as a result.

32. In the 2005 model, the budgetbalance semi-elasticities were derived using 2003 budget structure as weights. This may also explain part of the difference compared to semi-elasticities derived in this paper, in addition to revisions to individual tax and expenditure elasticities.

33. With about half of the countries having lower, and the other half having higher semi-elasticities than the EC estimates.

Table 10. Budget balance ratio semi-elasticities

	Output gap elasticity of current primary expenditure[1]	Share of current primary expenditure in total expenditure	Elasticities				Shares in %GDP		Semi elasticities				
			Total expenditure level[2]	Total revenue level[3]	Total expenditure to GDP ratio[4]	Total revenue to GDP ratio[4]	Total expenditure	Total revenue	Expenditure	Revenue	Budget balance		
		% of total expenditure, 2002-2011 average					2002-2011 average	2002-2011 average			Total	2005 estimates	Revision
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]
Australia	-0.19	92.77	-0.18	1.39	-1.18	0.39	34.22	33.89	-0.40	0.13	0.54	0.39	0.15
Austria	-0.13	89.77	-0.11	1.06	-1.11	0.06	51.32	48.51	-0.57	0.03	0.60	0.47	0.13
Belgium	-0.32	88.81	-0.29	1.04	-1.29	0.04	50.19	48.33	-0.65	0.02	0.66	0.52	0.14
Canada	-0.26	86.38	-0.22	1.16	-1.22	0.16	40.32	39.57	-0.49	0.06	0.56	0.38	0.18
Chile	-0.10	88.64	-0.09	1.13	-1.09	0.13	43.01	40.95	-0.47	0.06	0.52	..	..
Czech Republic	-0.10	91.42	-0.09	0.95	-1.09	-0.05	42.69	39.05	-0.47	-0.02	0.45	0.39	0.06
Denmark	-0.31	95.63	-0.29	0.95	-1.29	-0.05	53.18	54.42	-0.69	-0.03	0.66	0.59	0.07
Estonia	-0.06	89.35	-0.06	1.14	-1.06	0.14	37.69	37.94	-0.40	0.05	0.45	..	..
Finland	-0.18	95.10	-0.17	0.93	-1.17	-0.07	50.38	52.22	-0.59	-0.04	0.55	0.48	0.07
France	-0.14	91.68	-0.12	1.00	-1.12	0.00	53.74	49.67	-0.60	0.00	0.61	0.53	0.08
Germany	-0.15	91.07	-0.13	0.92	-1.13	-0.08	45.77	43.36	-0.52	-0.04	0.48	0.51	-0.03
Greece	-0.03	82.52	-0.03	0.93	-1.03	-0.07	47.86	39.58	-0.49	-0.03	0.46	0.47	-0.01
Hungary	-0.10	86.95	-0.08	1.03	-1.08	0.03	50.06	43.75	-0.54	0.01	0.56	0.47	0.09
Iceland	-0.20	84.03	-0.17	1.20	-1.17	0.20	44.88	42.25	-0.52	0.09	0.61	0.37	0.24
Ireland	-0.19	83.67	-0.16	1.02	-1.16	0.02	40.50	34.51	-0.47	0.01	0.48	0.38	0.10
Israel	-0.07	82.62	-0.06	1.09	-1.06	0.09	44.83	40.71	-0.48	0.04	0.51	..	..
Italy	-0.04	85.83	-0.03	1.01	-1.03	0.01	48.02	44.52	-0.50	0.01	0.50	0.53	-0.03
Japan	-0.07	89.12	-0.06	1.01	-1.06	0.01	38.22	32.49	-0.40	0.00	0.41	0.33	0.08
Korea	-0.08	76.77	-0.06	1.07	-1.06	0.07	29.28	31.94	-0.31	0.02	0.33	0.22	0.11
Latvia	-0.10	95.16	-0.09	0.92	-1.09	-0.08	37.07	33.98	-0.41	-0.03	0.38	..	..
Luxembourg	-0.12	90.22	-0.11	1.09	-1.11	0.09	41.65	42.66	-0.46	0.04	0.50	0.47	0.03
Mexico	-0.06	72.77	-0.04	0.94	-1.04	-0.06	21.09	22.10	-0.22	-0.01	0.21	..	..
Netherlands	-0.22	92.40	-0.20	0.99	-1.20	-0.01	44.90	42.74	-0.54	-0.01	0.54	0.53	0.01
New Zealand	-0.18	87.97	-0.15	1.11	-1.15	0.11	40.54	41.70	-0.47	0.04	0.51	0.37	0.14
Norway	-0.11	93.91	-0.10	1.01	-1.10	0.01	43.76	57.00	-0.48	0.01	0.49	0.53	-0.04
Poland	-0.07	88.37	-0.06	0.98	-1.06	-0.02	44.72	39.84	-0.47	-0.01	0.47	0.44	0.03
Portugal	-0.15	88.88	-0.13	1.03	-1.13	0.03	46.89	40.93	-0.53	0.01	0.54	0.46	0.08
Slovak Republic	-0.06	92.99	-0.05	0.89	-1.05	-0.11	39.85	35.51	-0.42	-0.04	0.38	0.37	0.01
Slovenia	-0.07	90.07	-0.06	0.90	-1.06	-0.10	45.97	42.97	-0.49	-0.04	0.45	..	..
Spain	-0.44	86.70	-0.38	1.16	-1.38	0.16	40.91	37.95	-0.57	0.06	0.63	0.44	0.19
Sweden	-0.16	94.79	-0.15	1.09	-1.15	0.09	53.49	54.09	-0.62	0.05	0.66	0.55	0.11
Switzerland	-0.13	91.89	-0.12	1.12	-1.12	0.12	33.42	33.08	-0.37	0.04	0.41	0.37	0.04
Turkey	-0.01	88.64	-0.01	1.08	-1.01	0.08	43.01	40.95	-0.43	0.03	0.47	..	..
United Kingdom	-0.10	89.31	-0.09	1.30	-1.09	0.30	43.41	38.36	-0.47	0.12	0.59	0.45	0.14
United States	-0.18	86.22	-0.16	1.18	-1.16	0.18	38.62	31.62	-0.45	0.06	0.50	0.34	0.16
OECD	**-0.14**	**88.64**	**-0.12**	**1.05**	**-1.12**	**0.05**	**43.01**	**40.95**	**-0.48**	**0.02**	**0.50**	**0.44**	**0.08**

Note: Shares in totals and shares in GDP are averages for 2002-2011 or of available years within that period (Mexico and Luxembourg). Shares of Chile and Turkey were set to the OECD average, due to missing data. OECD averages are unweighted averages.

1. See Table 8 column 5.
2. Product of columns 1 and 2.
3. See Table 9 column 9.
4. Equals to corresponding elasticties in level, minus 1.

Source: OECD calculations.

Table 11. Actual and cyclically-adjusted budget balances using new elasticity estimates

Percent of GDP / potential GDP

		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	Buget balance	2.2	2.5	1.9	-0.4	-4.1	-4.7	-3.4	-2.6	-1.4	-2.2
	Cyclically-adjusted balance	1.4	2.1	0.9	-0.9	-4	-4.2	-2.8	-2.4	-0.9	-1.7
Austria	Buget balance	-2.5	-2.5	-1.3	-1.5	-5.3	-4.5	-2.6	-2.2	-1.3	-2.4
	Cyclically-adjusted balance	-2.8	-3.7	-3.5	-3.4	-4.1	-3.5	-2.8	-2.3	-0.8	-1.4
Belgium	Buget balance	-2.6	0.2	0	-1.1	-5.5	-4	-4.1	-4.1	-2.9	-3.2
	Cyclically-adjusted balance	-2.9	-0.6	-1.7	-2.5	-4.3	-3.9	-4.4	-3.8	-2.1	-2.4
Canada	Buget balance	1.7	1.8	1.5	-0.3	-4.5	-4.9	-3.7	-3.1	-2.7	-1.6
	Cyclically-adjusted balance	0.9	0.9	0.7	-0.6	-2.3	-3.7	-3.1	-2.4	-2.1	-1.4
Chile[1]	Buget balance	5	8.4	8.3	3.1	-3.1	..	..	..	..	..
	Cyclically-adjusted balance	..	..	..	..	..	..	..	..	..	..
Czech Republic	Buget balance	-3.1	-2.3	-0.7	-2.1	-5.5	-4.4	-2.7	-3.9	-1.2	-2
	Cyclically-adjusted balance	-3.3	-3.9	-3.3	-4.7	-5.2	-4.4	-3	-3.4	0.2	-0.8
Denmark	Buget balance	5	5	5	3.2	-2.8	-2.7	-2.1	-3.7	-1.1	1.2
	Cyclically-adjusted balance	3.2	1.7	2	1.4	-0.7	-1.4	-1.3	-2.1	1.1	3.1
Estonia	Buget balance	1.1	2.9	2.5	-2.7	-2.2	0.2	1.2	-0.2	-0.2	0.6
	Cyclically-adjusted balance	-0.8	-1.4	-3.7	-5.4	3.8	4.8	2.8	0.4	0.8	1.8
Finland	Buget balance	2.6	3.9	5.1	4.2	-2.5	-2.6	-1	-2.1	-2.5	-3.2
	Cyclically-adjusted balance	2.5	2.8	2.2	1.5	-0.3	-2	-1.7	-1.8	-1.2	-1.4
France	Buget balance	-3.2	-2.3	-2.5	-3.2	-7.2	-6.8	-5.1	-4.8	-4.1	-4
	Cyclically-adjusted balance	-3.8	-3.7	-4.4	-4.2	-5.8	-6	-5	-4.2	-3.2	-2.4
Germany	Buget balance	-3.3	-1.5	0.3	0	-3	-4.1	-0.9	0.1	0.1	0.6
	Cyclically-adjusted balance	-2.4	-1.9	-0.9	-0.9	-0.6	-3	-0.9	0.4	0.8	1.1
Greece	Buget balance	-5.5	-6.1	-6.7	-9.9	-15.3	-11.1	-10.2	-8.7	-12.3	-3.6
	Cyclically-adjusted balance	-6.6	-9.1	-11	-14	-17.7	-11.3	-6.7	-2.6	-4.3	2.6
Hungary	Buget balance	-7.9	-9.3	-5	-3.6	-4.6	-4.5	-5.5	-2.3	-2.4	-2.5
	Cyclically-adjusted balance	-10.1	-12.8	-7.8	-6.1	-3.1	-3.4	-5	-0.7	-1.2	-2.3
Iceland	Buget balance	4.7	6.2	5.1	-12.9	-9.4	-9.5	-5.3	-3.7	-2	-0.2
	Cyclically-adjusted balance	1.8	3.7	-0.1	-17.7	-8.9	-6.1	-2.7	-1	-0.6	0.9
Ireland	Buget balance	1.3	2.8	0.3	-7	-13.9	-32.6	-12.8	-8.1	-5.8	-4.1
	Cyclically-adjusted balance	-1.5	-0.6	-3.7	-8.4	-10.7	-27.2	-9.8	-4.9	-2.4	-2.4
Israel	Buget balance	-4.1	-1.7	-0.6	-2.7	-5.6	-4	-3.3	-5	-4.1	-3.7
	Cyclically-adjusted balance	-2.5	-1.1	-1.2	-3.4	-5.5	-4.8	-4.2	-5.4	-4.3	-3.6
Italy	Buget balance	-4.2	-3.6	-1.5	-2.7	-5.3	-4.2	-3.5	-3	-2.9	-3
	Cyclically-adjusted balance	-4.8	-4.9	-3.2	-3.6	-3.2	-3	-2.6	-0.7	0.2	0.2
Japan	Buget balance	-4.8	-1.3	-2.1	-1.9	-8.8	-8.3	-8.8	-8.7	-8.5	-7.7
	Cyclically-adjusted balance	-4.9	-1.8	-3.2	-2.3	-6.8	-8	-8.1	-8.5	-8.8	-7.7
Korea	Buget balance	1.6	2.3	4.2	2.3	-1.3	1	1	1	1.3	1.6
	Cyclically-adjusted balance	1.5	1.9	3.3	1.7	-0.8	0.5	0.6	1.1	1.7	2.1
Latvia[1]	Buget balance	-0.4	-0.6	-0.6	-4	-9	-8.1	-3.3	-0.8	-0.7	-1.4
	Cyclically-adjusted balance	-2.2	-4.7	-6.8	-8	-6.3	-4.3	-1.4	0.1	-0.5	-1.2
Luxembourg	Buget balance	0.2	1.4	4.2	3.3	-0.5	-0.5	0.4	0.1	0.9	0.6
	Cyclically-adjusted balance	..	0.1	1.3	1.4	1.6	0	0.9	2	2.9	2.4
Mexico[1]	Buget balance	1.6	0.7	0.2	-0.2	-0.6	-0.6	-0.1	0	0.1	-0.3
	Cyclically-adjusted balance	..	..	..	..	..	..	..	..	..	..
Netherlands	Buget balance	-0.3	0.2	0.2	0.2	-5.5	-5.1	-4.4	-4	-2.3	-2.3
	Cyclically-adjusted balance	0.3	-0.4	-1.7	-2	-5.3	-5.1	-4.9	-3.2	-0.8	-0.8
New Zealand	Buget balance	4.6	5.1	4.4	0.4	-2.9	-6.8	-3.5	-1.6	0.3	1.4
	Cyclically-adjusted balance	3.5	4.3	2.9	0.6	-2.1	-6.1	-2.6	-1	0.8	1.6
Norway	Buget balance	-0.6	1.9	4.4	3	-0.9	-0.6	-0.1	0.3	-0.3	-0.6
	Cyclically-adjusted balance	-0.3	0.7	1.6	1	-0.1	0.3	0.7	0.3	-0.2	-0.4
Poland	Buget balance	-4.3	-3.7	-2.1	-3.9	-7.5	-7.6	-4.9	-3.7	-4	-3.2
	Cyclically-adjusted balance	-2.5	-2.9	-2.6	-4.3	-7.2	-7.5	-5.5	-3.7	-3.5	-2.9
Portugal	Buget balance	-6.2	-4.3	-3	-3.8	-9.8	-11.2	-7.4	-5.6	-4.8	-4.5
	Cyclically-adjusted balance	-6.1	-4.5	-4.1	-4.6	-8.7	-11	-6.2	-2.4	-0.5	-0.7
Slovakia	Buget balance	-2.9	-3.6	-1.9	-2.4	-7.9	-7.5	-4.1	-4.2	-2.6	-2.9
	Cyclically-adjusted balance	-1.5	-3.8	-4.4	-5.4	-7.8	-8.1	-4.5	-4.2	-2.2	-2.3
Slovenia	Buget balance	-1.5	-1.3	-0.1	-1.8	-6.1	-5.6	-6.6	-4	-14.9	-4.9
	Cyclically-adjusted balance	-1.6	-2.6	-3	-5.2	-5.1	-4.9	-6.1	-2.3	-12	-3.2
Spain	Buget balance	1.2	2.2	2	-4.4	-11	-9.4	-9.4	-10.3	-6.8	-5.8
	Cyclically-adjusted balance	-0.2	0	-0.9	-6.7	-10	-7.8	-7.1	-6.2	-1.9	-1.6
Sweden	Buget balance	1.8	2.2	3.3	2	-0.7	0	-0.1	-0.9	-1.4	-1.9
	Cyclically-adjusted balance	1.3	-0.1	0.3	0.8	2.5	0.5	-0.1	0.2	0.2	-0.5
Switzerland	Buget balance	-1.2	0.3	0.9	2	0.8	0.3	0.8	0.3	0.1	0.2
	Cyclically-adjusted balance	-1	-0.2	-0.2	0.9	1.2	0.4	0.8	0.6	0.5	0.6
Turkey[1]	Buget balance	..	0.8	-1.2	-2.2	-6.7	..	..	..	..	..
	Cyclically-adjusted balance	..	..	..	..	..	..	..	..	..	..
United Kingdom	Buget balance	-3.5	-2.9	-3	-5	-11	-9.6	-7.6	-8.3	-5.5	-5.3
	Cyclically-adjusted balance	-4.4	-4.6	-5	-6	-8.7	-8.1	-6.5	-6.9	-4.5	-4.9
United States	Buget balance	-4.2	-3.1	-3.7	-7.2	-12.8	-12.2	-10.7	-9	-5.7	-5
	Cyclically-adjusted balance	-5.6	-4.7	-5	-7.2	-10.4	-10.1	-8.6	-7.2	-4.1	-3.7

1. The OECD Economic Outlook 97 database does not have all the fiscal variables required to calculate cyclically-adjusted balances for Chile, Mexico and Turkey.

Source: OECD Economic Outlook 97 database and OECD calculations.

2. Cyclically adjusted balances

44. Cyclically adjusted budget balances calculated with the new elasticities are reported in Table 11 for recent years. They are also shown in Figure 1 for a longer time span, together with the last set of published estimates (based on the 2005 set of elasticities) from the OECD Economic Outlook n° 97. In general, the amplitude of the structural balance is reduced somewhat under the new elasticities compared with the previous ones, because more of the variation in the actual budget balance is identified as cyclical. For a number of economies, structural budgets are weaker in the pre-financial crisis period than they appeared to be under the previous elasticities.

45. The annual change in the CAB can be interpreted as a measure of the discretionary fiscal policy, calculated as the residual change in the fiscal balance after removing built-in stabilisers. As with the level of the CAB, its annual change is also highly dependent on estimates of the output gap, but an advantage of this subtractive approach is its relative simplicity and the fact that the cyclically adjusted budget balance obtained does not depend on a 'bottom-up' itemisation of discretionary budget measures. It therefore gives a clearer picture of aggregate fiscal leverage. In particular, it shows a clear pro-cyclical deterioration in the CAB in many countries prior to the financial crisis (Germany, Italy, Japan being exceptions), followed by an immediate marked counter-cyclical response during 2008 and 2009. The extended period of fiscal tightening which then followed is also clearly evident from the cyclically adjusted budget indicator.

Figure 1. Actual and cyclically-adjusted balances using 2005 and new elasticity estimates

Per cent of GDP, per cent of potential GDP

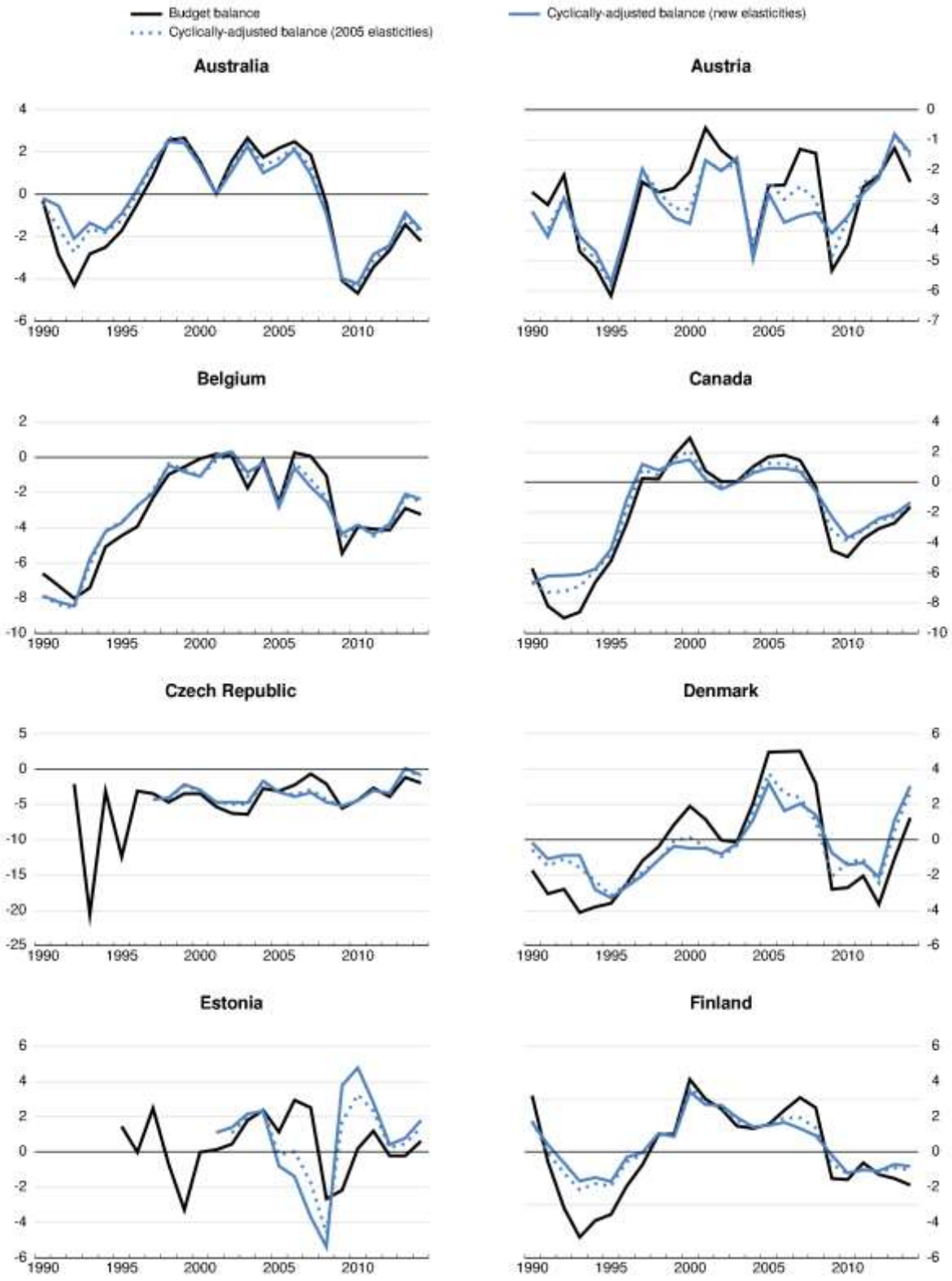


Figure 1. Actual and cyclically-adjusted balances using 2005 and new elasticity estimates (cont'd)

Per cent of GDP, per cent of potential GDP

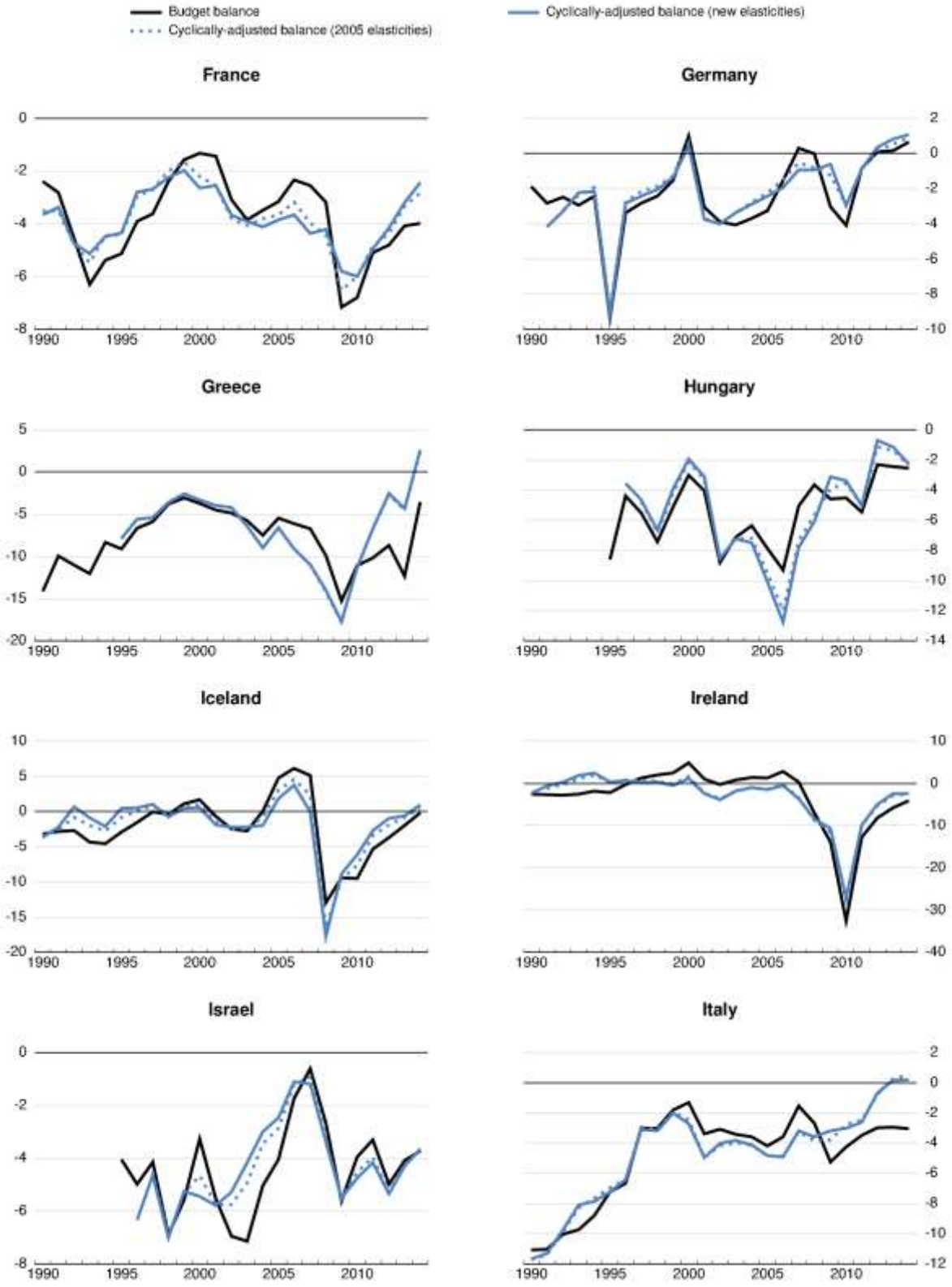


Figure 1. Actual and cyclically-adjusted balances using 2005 and new elasticity estimates (cont'd)

Per cent of GDP, per cent of potential GDP

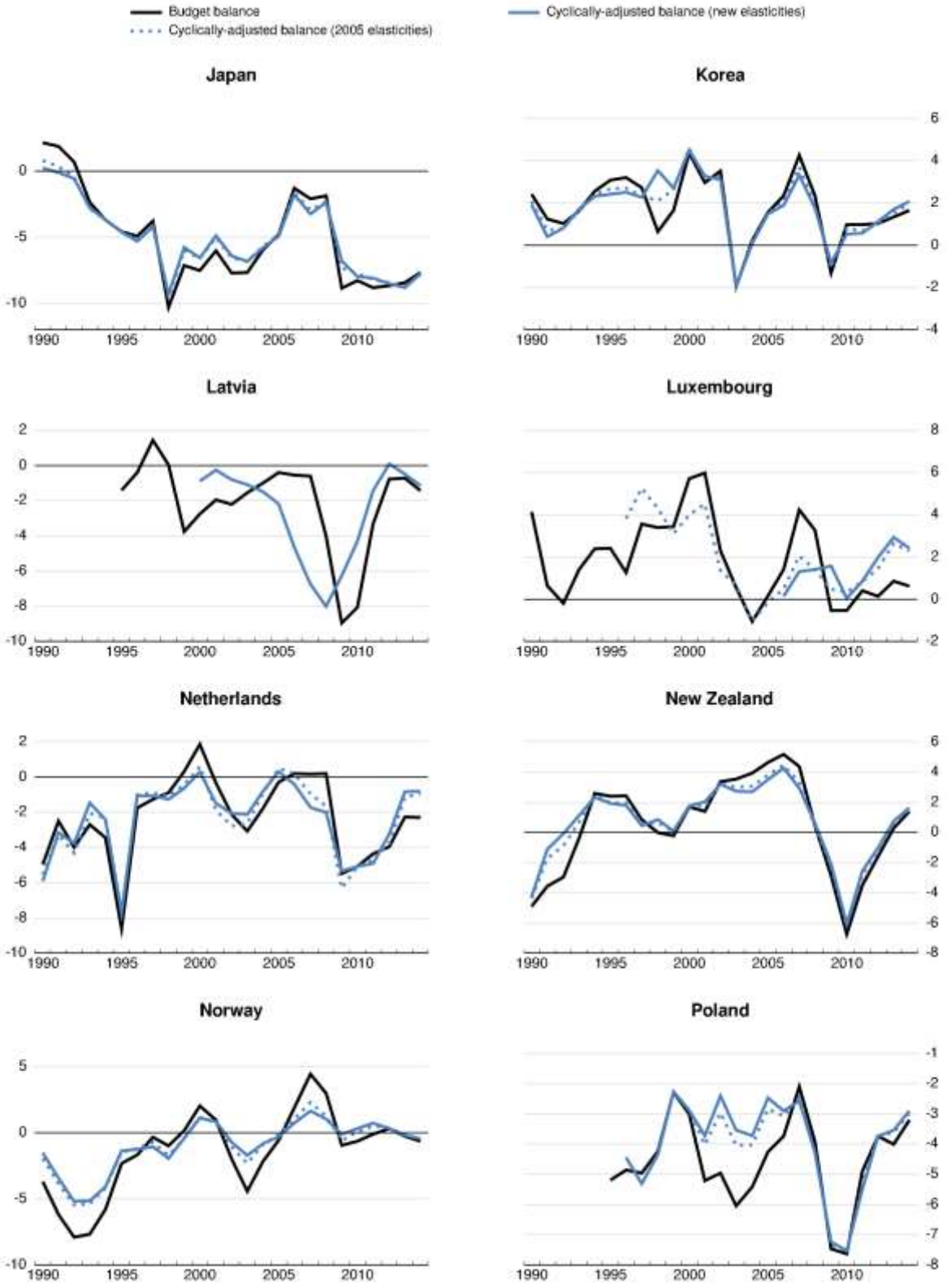
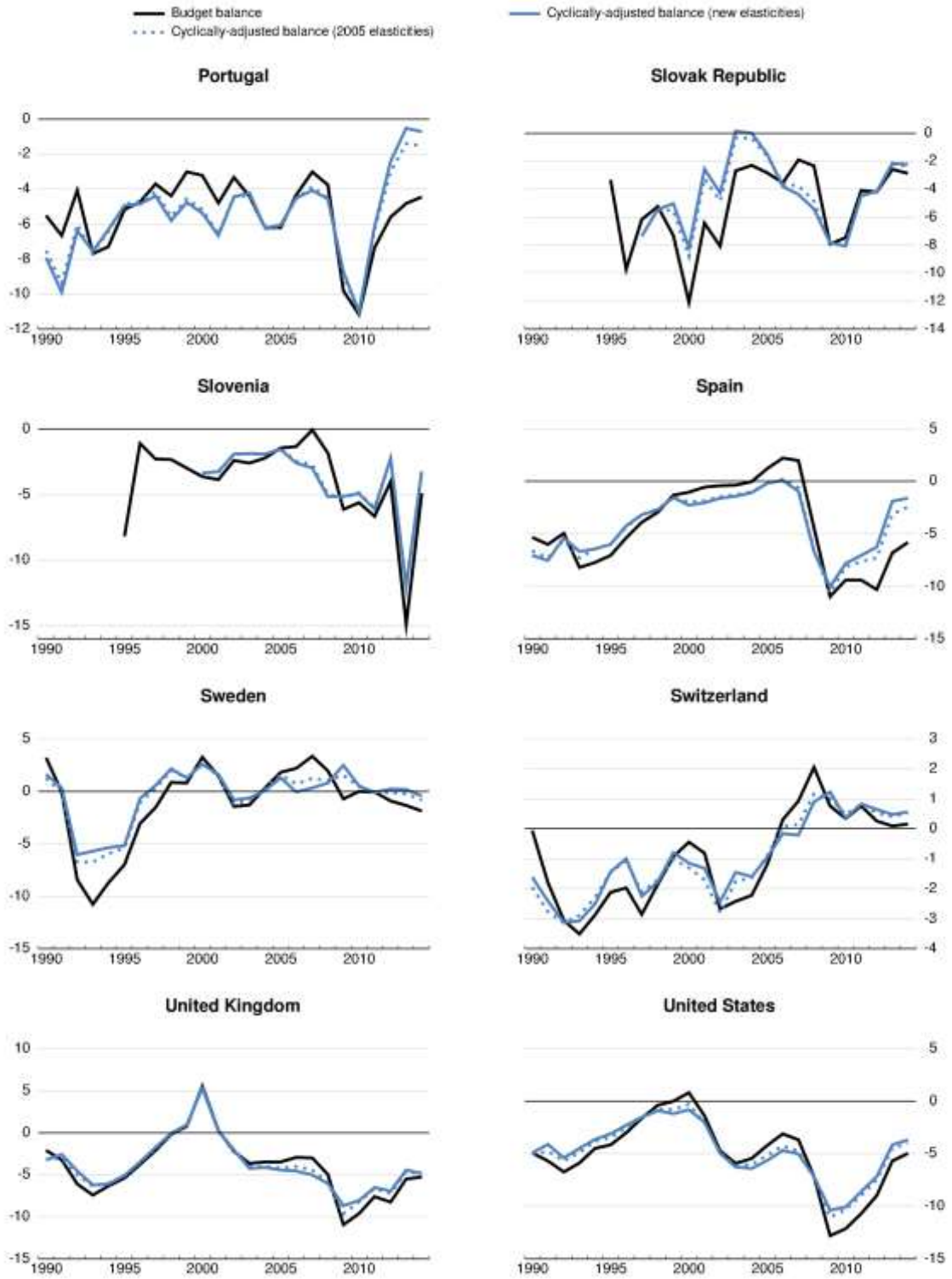


Figure 1. Actual and cyclically-adjusted balances using 2005 and new elasticity estimates (cont'd)

Per cent of GDP, per cent of potential GDP



Note: The OECD Economic Outlook 97 database does not have all the fiscal variables required to calculate cyclically-adjusted balances for Chile, Mexico and Turkey.

Source: OECD Economic Outlook 97 Database and OECD calculations.

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METHODOLOGICAL AND STATISTICAL ANNEX

I. COMPUTATION OF INCOME-TAX AND SOCIAL SECURITY-CONTRIBUTION ELASTICITIES

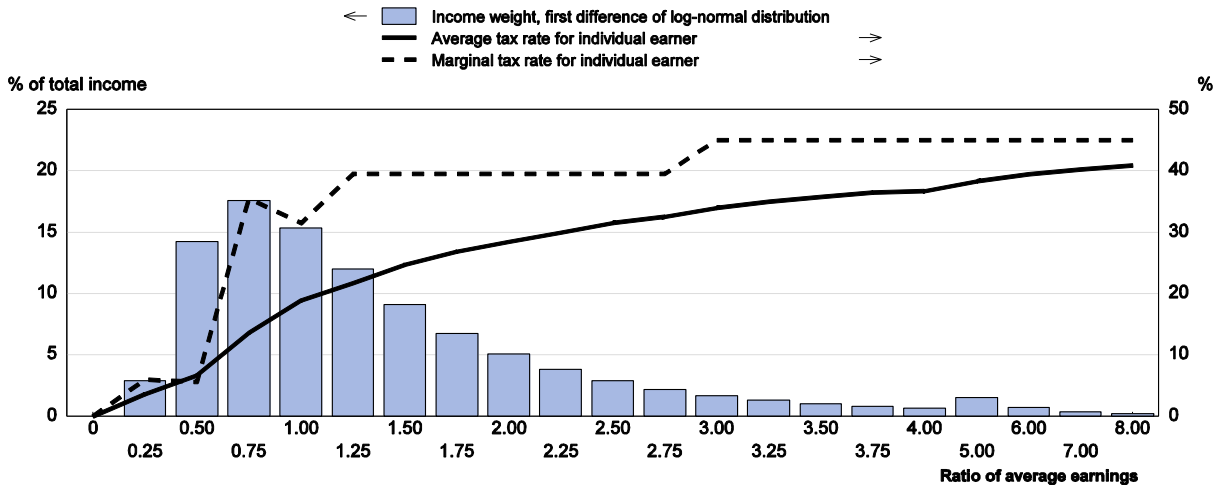
Elasticities with respect to earnings

1. The elasticities of personal income tax and social security contributions with respect to earnings are calculated from cross-section data on tax and income per worker, along an income distribution calibrated in terms of ratios of average earnings[1] (Figure A1.1 and Table A1.1). Average and marginal rates of tax can be measured at each point along the income distribution (columns 2 and 3 of Table A1.1) and weighted averages of marginal and average rates can be derived by applying the relevant income weights derived from the applied lognormal income distribution (right axis of Figure A1.1 and columns 5 and 6 of Table A1.1). The weighted elasticity is simply the ratio of the weighted marginal rate (column 8) divided by the weighted average rate (column 7):

$$\mathcal{E}_{t,ye} = MR/AR = \Sigma\omega_{ye,i}(mr_i)/\,\Sigma\omega_{ye,i}(ar_i) \tag{A1}$$

where: $\mathcal{E}_{t,ye}$ = the aggregate tax (social security contribution) elasticity with respect to earnings (*ye*), mr_i = the marginal rate at point *i* on the earnings distribution; ar_i = the average rate, $\omega_{ye,i}$ = the weight of earnings at income level *i* in total earnings and *MR* and *AR* are the weighted marginal and average rates of tax, respectively.

Figure A1.1. Marginal and average tax rates with income distribution



Source: See Table A1.1.

1. There are statistical methods which, in principle, could provide more precise estimates of tax and social security contributions with respect to earnings, such as microsimulation models, but these were not used here due to data limitations.

Table A.1.1 Derivation of weighted average elasticity from individual tax codes

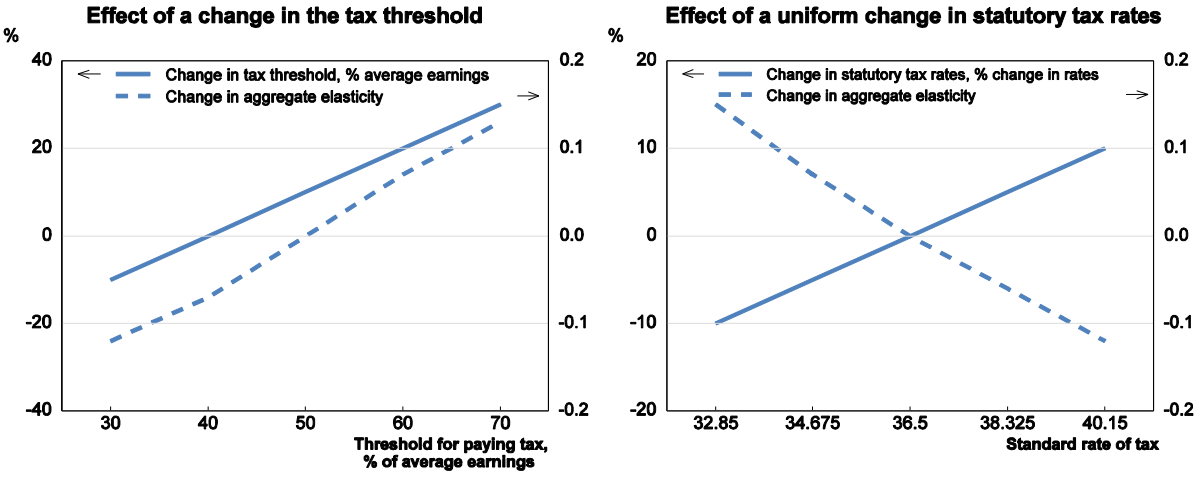
Income as a ratio of average earnings	Tax rate for individual earner		Tax elasticity facing individual	Log-normal income distribution	Income-weighted aggregate		
	Average rate	Marginal rate			First difference of log-normal distribution	Marginal rate	Average rate
1	2	3	4	5	6	7	8
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.25	0.04	0.06	1.67	0.03	0.03	0.00	0.00
0.50	0.07	0.05	0.83	0.17	0.14	0.01	0.01
0.75	0.14	0.35	2.60	0.35	0.18	0.02	0.06
1.00	0.19	0.31	1.66	0.50	0.15	0.03	0.05
1.25	0.22	0.39	1.81	0.62	0.12	0.03	0.05
1.50	0.25	0.39	1.60	0.71	0.09	0.02	0.04
1.75	0.27	0.40	1.47	0.78	0.07	0.02	0.03
2.00	0.28	0.40	1.39	0.83	0.05	0.01	0.02
2.25	0.30	0.40	1.32	0.87	0.04	0.01	0.01
2.50	0.32	0.40	1.25	0.90	0.03	0.01	0.01
2.75	0.33	0.40	1.22	0.92	0.02	0.01	0.01
3.00	0.34	0.45	1.33	0.93	0.02	0.01	0.01
3.25	0.35	0.45	1.29	0.95	0.01	0.00	0.01
3.50	0.36	0.45	1.26	0.96	0.01	0.00	0.00
3.75	0.37	0.45	1.23	0.96	0.01	0.00	0.00
4.00	0.37	0.45	1.23	0.97	0.01	0.00	0.00
5.00	0.38	0.45	1.17	0.99	0.02	0.01	0.01
6.00	0.39	0.45	1.14	0.99	0.01	0.00	0.00
7.00	0.40	0.45	1.12	1.00	0.00	0.00	0.00
8.00	0.41	0.45	1.10	1.00	0.00	0.00	0.00
				Weighted average		**0.20**	**0.32**
				Aggregate elasticity (MR/AR)		**1.60**	

Source: OECD calculations; example based on a married couple with no children, in the Australian tax system.

2. The aggregate elasticity will depend particularly on the distribution of income around the income tax threshold, where the elasticity (the ratio of the marginal to average rate) tends to be higher. Hence the higher the proportion of taxpayers above but near the threshold, the higher the elasticity. Correspondingly, in terms of changes to the elasticities between the present and 2005 exercises, those countries which have raised their tax thresholds will tend to have higher elasticities than previously (and vice-versa). This is demonstrated in Figure A1.2 (based on the Austrian tax schedule/income distribution) where the elasticity rises linearly as the threshold increases from 40% of average earnings or decreases as the threshold falls. The intuition here is that allowances push the tax schedule further from proportionality, raising the marginal rate relative to the average rate. By the same token, since families with children tend to have more allowances than single earners, the tax elasticity applying to a family with two children will be higher than that applying to a single earner at the same level of average earnings. For the above reason, using a family with two children as the representative taxpayer can bias the elasticity upward, so for the PIT the analysis uses an average of three family types[2]. This is not so crucial for social security contributions, which is usually proportional up to a certain ceiling.

2. An exception is Italy, where to take account of the particular tax structure; the elasticity is an average of a married couple with 0 and 2 children.

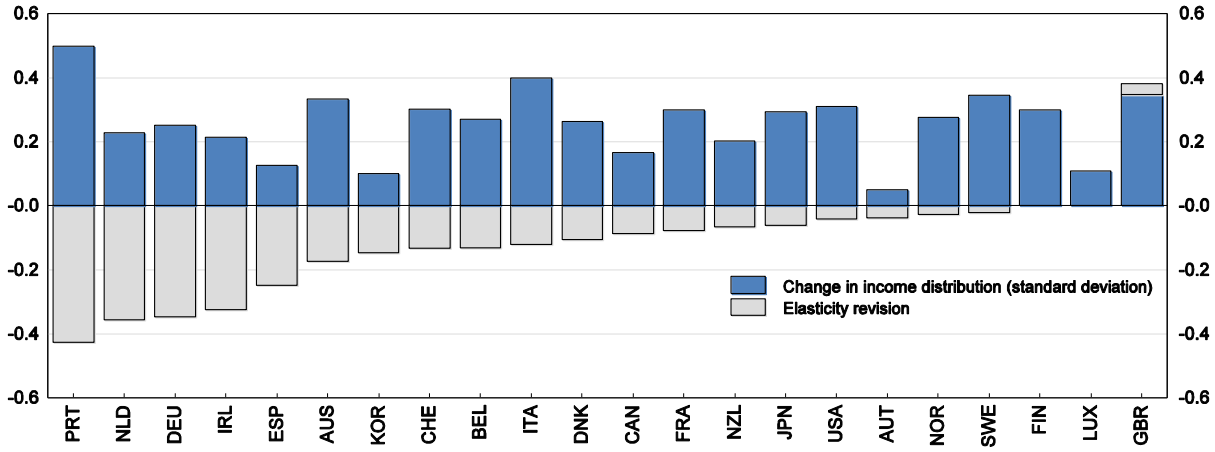
Figure A1.2. Tax elasticity effects of changes in allowances and rates



Source: OECD calculations.

3. With respect to rate changes, increasing the highest rates of tax (*increasing the slope of the tax schedule*) increases the aggregate elasticity, but the effects of such increased tax progression tend to be small because of the low income weight attached to higher income earners. However, *proportional* increases in statutory rates (upward or downward *shifts in the tax schedule*), as in the second panel reduce the elasticity for a given positive threshold, since uniformly higher rates increase the average rate more than the marginal rate.

Figure A1.3. Effects of income distribution revisions on tax elasticities



Source: OECD calculations.

4. Incorporating a higher log-normal distribution of income towards higher incomes, as in the current exercise, will generally result in a lower elasticity because it gives a lower weight to incomes with a higher elasticity. This can be quite marked, as in the case of the Netherlands, Germany, Ireland and Spain, though the impact is not uniform across countries (Figure A1.3).

Data sources for PIT and income distribution

5. Tax/income distributions are available from a number of complementary data sets:

1. The OECD *Tax/benefits* data set (T/B) covers income taxes, employee social security contributions and income-related social benefits, by percentile from 0 to 2 × average earnings. The cross-section data refer to 2010 – 2011, and these have been updated, where possible, to allow for more recent tax reforms.[3] This data set is treated as the primary source of elasticity calculations, because it contains the most information about the components of tax and benefits, but has been augmented in two ways:

   - The income range has been extended to up to 8 x average earnings by applying the relevant tax schedules.

   - Employer social security contributions have been added, using the relevant social security schedules.

2. The *OECD Income Distribution and Poverty* (D/P) data set gives income taxes plus employee contributions (as an aggregate) by population decile. The per capita income distribution covers the whole range from 0 to the highest earners and income weights per decile can be calculated. The data relate to 2010.

3. The OECD publication *Taxing Wages* (OECD 2012a) provides data on statutory, marginal and average income tax rates by level of gross earnings by half-percentile from 0 to 5 × average earnings for all OECD economies. The data relate to the 2010 and 2003 schedules. These data have been used to calculate the elasticities for the countries not covered under 1) and to calculate the effects of rate changes between 2003 and 2010.

4. National sources have been used, where available, to check the consistency of the elasticity aggregates and to identify the elasticities relating to the components of the income tax base. These data are not available in a comparable, consistent or systematic form.

6. The income distribution data needed to apply the earnings weights ω_i to the tax/income scales are not available in the tax/benefit data set. Aggregate rates and elasticities are thus estimated by applying a lognormal income distribution system which replicates the income distributions in the *Income Distribution and Poverty* data set: specifically by applying the relevant standard deviations. As noted, the log-normal distribution is applied to an income range which allows for a distribution of income up to 0 to 8 x average earnings, whereas the previous exercise imposed a log-normal distribution of income over the income range 0.5 to 3 × the average wage (then defined in relation to the average production worker). The new income-weighting system results in significant aggregate elasticity revisions for a number of countries (Figure A1.3).

3. In the case of France, the published tax data have been adjusted to correspond to the 2014 PIT schedule.

7. A further issue in the process of aggregation using the *Tax/Benefit* data set is the definition of the 'representative' wage-earner, which is defined by family type. The 2005 analysis used a family with two children with the second earner on two-thirds average income. In fact, this group would be likely to have a higher elasticity than other groups, because it has the highest allowances. The new analysis is thus based on averaging three family types: single earners, childless couples and couples with 2 children, with the second earner on two-thirds of average income. This has the effect of reducing the income tax elasticities, on average, by 0.1.

8. For most countries, differences in method, plus statutory rate changes can explain the differences between the new income tax elasticity estimates and the previous ones. For a few countries the difference is significant, probably due to unidentified legislative changes (to allowances, etc). As a cross-check on the reliability of the new estimates, the aggregate elasticities for *tax plus employee social security* are compared with those derived from the *Income Distribution and Poverty* data set in the final columns of Table 2 in the main text. For most countries the elasticities correspond closely, the primary data set giving elasticities higher, on average, by around 0.1.

Including other components of the income tax base

9. The income tax base is comprised not just of wages and salaries (earnings) but also of self-employment income, transfers and income from capital. The regimes covering these other income categories may differ from that applying to wages and salaries, leading to different tax/tax base elasticities, while – more importantly – the tax bases may display very different cyclical behaviour from wages and salaries. To account for these differences, elasticities for these non-earnings income categories are estimated separately from the *Income Distribution and Poverty* data set, using the same method as for earnings:

$$\mathcal{E}_{tk,tbk} = MR_{tk}/AR_{tk} = \Sigma\omega_{ki}(mr_i)/\Sigma\omega_{ki}(ar_i) \tag{A2}$$

where $\mathcal{E}_{tk.tbk}$ is the elasticity of tax on income component k with respect to its base; $\omega_{k.i}$ = the income of the kth income category of income tax at income-level i in total kth income; mr_i and ar_i are the marginal and average rates by income level, and MR and AR are the weighted average marginal and average rates[4]. The tax/income distribution exists only for deciles in this data set and the tax aggregate relates only to PIT plus employee contributions, which necessitated some adaptation:

- For *self-employment income*, the estimated elasticity was separated into PIT and social security components by taking the social security elasticity as that applying to earnings;

- For *capital income*, the procedure adopted has been to use the income-distribution information derived from the *Income Distribution and Poverty* data set (the standard deviation of capital income) to estimate a lognormal distribution of capital income which can be applied to the *Tax/Benefit* data set. These income weights can then be used to generate tax/capital income elasticities for PIT in the same way as for earned income, as per equation 3.

4. Self-employed face the same tax schedule as earned incomes so that marginal rates apply equally to each type of income recipient (i.e mr_i is the same for each category). A similar process can be applied to capital income, on the grounds that an individual faces the same marginal rate of tax on incremental changes due to earned or unearned income additions.

10. The basic model used for calculating the income tax/capital income elasticity is one that relates to systems where capital income is aggregated with other income to arrive at total taxable income: i.e. the values of mr_i are taken as identical for capital and earned income.[5] This applies to the majority of OECD economies. Where the capital tax regime differs, mainly through the application of a flat tax, or a dual or semi-dual income tax system, the marginal rate schedules in the *Tax/Benefit* data set have been adjusted to match the rates applicable to capital income. A flat tax imposed without any allowances would be expected to generate a capital income elasticity of exactly 1, whereas applying a uniform tax rate on capital income above a certain threshold would be expected to generate a capital income elasticity higher than one, depending on the height of that threshold, but lower than countries applying a progressive higher-rate schedule.

11. A composite PIT elasticity with respect to personal income can then be computed as a weighted average of the component elasticities, using the income in each category as weights. National accounts income weights are used as a proxy for the amount of PIT accruing for each income category, for which data are not available on a systematic basis.

12. Using income in each category as a proxy for tax paid in each category is problematic in the case of transfers, where transfers can account for a much higher proportion of income than of taxes, since some transfers may not be taxed. This would bias the aggregate elasticity down. The approach used here has thus been to calculate the aggregate elasticity as a weighted average of the elasticities applying to wages, self-employed income and capital income (Table A1.2, cols. 1-4). (This is equivalent to assuming that that the PIT/transfer elasticity is equal to the average of other income categories.)

5. In the case of the Netherlands, taxable investment income is determined on the basis of a deemed return on capital, fixed at 4% of the net capital, applied after deduction of an exempt amount. Taxable income is thus computed without regard to the actual income received, so that the elasticity is calculated as if capital values increase pari passu with income.

Table A1.2. Personal income component tax and output gap elasticities

	Tax revenue to tax base elasticities				Tax base to output gap elasticities[1]				Tax revenue to output gap elasticities				Tax weights		
	Earnings	Self employed	Capital income	**Personal income tax[2]**	Earnings	Self employed	Capital income[3]	**Personal income tax[2]**	Earnings	Self-employment	Capital income	**Personal income tax[2]**	Earnings	Self employed	Capital income
	[1]	[2]	[3]	**[4]**	[5]	[6]	[7]	**[8]**	[9]	[10]	[11]	**[12]**	[14]	[15]	[16]
Australia	1.62	1.47	1.51	**1.60**	1.03	1.29	4.57	**1.43**	1.67	1.90	6.91	**2.25**	0.74	0.06	0.10
Austria	2.00	1.85	1.70	**1.97**	0.77	0.96	3.81	**0.94**	1.55	1.78	6.46	**1.81**	0.61	0.10	0.04
Belgium	1.63	1.39	1.69	**1.62**	0.63	1.13	3.97	**0.83**	1.03	1.57	6.69	**1.34**	0.68	0.07	0.04
Canada	2.06	1.60	2.12	**2.04**	0.89	0.70	2.25	**1.06**	1.84	1.12	4.78	**2.19**	0.70	0.07	0.12
Chile	2.76	1.31	1.28	**2.16**	0.68	0.81	2.92	**1.01**	1.88	1.06	3.74	**1.90**	0.57	0.27	0.13
Czech Republic	2.24	2.24	1.77	**2.23**	0.84	1.35	2.03	**0.96**	1.88	3.03	3.59	**2.13**	0.63	0.14	0.02
Denmark	1.44	1.38	1.39	**1.43**	0.54	1.22	1.84	**0.69**	0.78	1.68	2.56	**0.98**	0.71	0.05	0.07
Estonia	1.46	1.45	1.46	**1.46**	1.03	0.92	3.54	**1.07**	1.50	1.33	5.16	**1.56**	0.76	0.02	0.01
Finland	1.50	1.43	1.32	**1.48**	0.70	1.22	3.70	**0.94**	1.04	1.75	4.89	**1.36**	0.65	0.06	0.05
France	1.73	1.69	1.38	**1.68**	0.73	1.33	3.52	**1.17**	1.27	2.24	4.86	**1.85**	0.58	0.06	0.10
Germany	1.90	1.87	1.74	**1.88**	0.61	1.97	1.82	**1.00**	1.15	3.69	3.17	**1.86**	0.57	0.17	0.06
Greece	2.30	2.14	1.59	**2.21**	0.66	1.14	3.02	**0.96**	1.52	2.43	4.80	**2.00**	0.49	0.22	0.05
Hungary	1.84	1.74	1.50	**1.80**	0.87	0.96	3.02	**1.02**	1.60	1.67	4.52	**1.80**	0.47	0.07	0.04
Iceland	1.73	1.44	1.67	**1.72**	0.88	1.12	3.02	**1.06**	1.52	1.62	5.05	**1.81**	0.74	0.02	0.07
Ireland	2.11	1.61	1.81	**2.04**	0.74	0.91	1.51	**0.77**	1.55	1.47	2.73	**1.57**	0.60	0.09	0.01
Israel	1.94	1.43	1.61	**1.83**	0.75	1.24	3.02	**1.05**	1.45	1.78	4.87	**1.85**	0.67	0.13	0.09
Italy	1.84	1.89	1.75	**1.85**	0.57	0.81	3.51	**0.78**	1.05	1.52	6.13	**1.43**	0.49	0.21	0.04
Japan	1.88	1.78	1.80	**1.87**	0.82	1.09	2.26	**0.95**	1.54	1.94	4.07	**1.76**	0.69	0.05	0.06
Korea	2.36	1.97	1.98	**2.24**	1.03	1.16	3.02	**1.20**	2.44	2.28	5.99	**2.64**	0.66	0.23	0.06
Latvia	1.29	1.24	1.60	**1.31**	0.73	1.28	3.02	**0.97**	0.94	1.59	4.83	**1.32**	0.65	0.10	0.06
Luxembourg	2.28	1.92	1.86	**2.24**	0.58	1.25	3.02	**0.72**	1.31	2.40	5.61	**1.56**	0.67	0.05	0.03
Mexico	2.22	1.45	1.64	**2.08**	0.75	1.24	3.02	**0.97**	1.66	1.79	4.95	**1.91**	0.73	0.12	0.06
Netherlands	2.15	1.84	1.20	**2.00**	0.71	1.93	2.58	**1.08**	1.54	3.55	3.09	**1.94**	0.67	0.08	0.11
New Zealand	1.38	1.30	1.23	**1.35**	0.64	1.45	2.02	**0.93**	0.88	1.88	2.49	**1.23**	0.65	0.10	0.12
Norway	1.53	1.54	1.52	**1.53**	0.84	1.06	3.02	**1.07**	1.28	1.63	4.58	**1.63**	0.67	0.05	0.08
Poland	1.96	1.84	1.51	**1.93**	0.95	0.80	3.02	**0.98**	1.87	1.47	4.58	**1.87**	0.64	0.12	0.02
Portugal	2.22	1.73	1.91	**2.15**	0.98	1.34	3.02	**1.08**	2.17	2.31	5.76	**2.29**	0.66	0.09	0.02
Slovak Republic	2.47	2.20	1.93	**2.43**	0.67	0.94	4.66	**0.74**	1.65	2.06	9.00	**1.77**	0.68	0.09	0.01
Slovenia	2.15	2.19	1.64	**2.14**	0.65	1.60	3.02	**0.77**	1.40	3.50	4.95	**1.62**	0.71	0.05	0.02
Spain	1.93	1.48	1.83	**1.88**	0.86	1.01	3.41	**0.94**	1.65	1.48	6.24	**1.76**	0.67	0.08	0.02
Sweden	1.45	1.21	1.17	**1.42**	0.77	1.06	3.39	**1.06**	1.12	1.29	3.96	**1.43**	0.68	0.03	0.08
Switzerland	1.92	1.46	1.80	**1.87**	0.69	0.86	3.91	**1.05**	1.32	1.25	7.03	**1.93**	0.72	0.07	0.10
Turkey	1.53	1.45	1.51	**1.51**	0.72	1.26	3.02	**1.19**	1.11	1.83	4.57	**1.78**	0.49	0.21	0.11
United Kingdom	1.50	1.49	1.48	**1.49**	0.61	2.97	3.39	**1.15**	0.91	4.42	5.03	**1.71**	0.67	0.08	0.09
United States	1.65	1.50	1.62	**1.64**	1.18	1.69	1.84	**1.27**	1.95	2.54	2.98	**2.08**	0.77	0.05	0.08
OECD	**1.88**	**1.64**	**1.61**	**1.83**	**0.77**	**1.23**	**3.02**	**1.00**	**1.46**	**2.02**	**4.87**	**1.77**	**0.65**	**0.10**	**0.06**

Note: OECD averages are unweighted averages.

1. For earnings and self-employment income, output gap elasticities refer to adjusted elasticities. See Annex Table A.1.10 for detailed calculations.
2. Average using weights in columns 14 to 16.
3. See Annex Table A.1.9 for detailed estimations of capital income to output gap elasticities. Non statistically significant estimates (NS) or missing values (NA) are set to the OECD average.

Source: OECD calculations.

II. ESTIMATING INDIRECT AND CORPORATE TAX ELASTICITIES

13. As discussed in the main text, for corporation and indirect taxes the approach adopted is to estimate the tax elasticities directly from time series data. The analysis has been based on an error-correction model (ECM), following the approach of Bruce et al. (2006) and Wolswijk (2007). Unlike a first-difference model an ECM specification allows for the effective elasticity to vary with the cycle (Box A1).

Box A1. Cyclical adjustment in the ECT model

Within a standard short-term model framework, we have:

- The tax-to-tax base equation, based on a standard model and expressed in first differences. This provides an estimate of the short-term tax elasticity (α) derived as follows:

  (1) $\Delta \ln T_i = c + \alpha \Delta lnTB_i + u$

- The tax base to output equation, with the short-term elasticity (δ) is derived as:

  (2) $\Delta \ln TB_i = c + \delta \Delta lnY_t + u$

Substituting (2) into (1), the tax equation is directly related to output. The output tax elasticity is derived as the product of the 2 preceding elasticities (e=αδ):

$$\Delta \ln T_{i,t} = c + [\alpha\partial]\Delta lnY_t + ut$$

The non-linear log form is the following:

$$T_{i,t} = Y_t^{\propto\partial}$$

- The cyclical adjustment of the tax revenue is obtained by using the tax equation both at the current Y level and the potential level Y^*

(3) $T_{i.t}^* = T_i \left(\frac{Y_t^*}{Y_t}\right)^{\propto\partial}$

Using an ECT tax equation model, the tax equation is expressed as follows:

- (1') $\Delta \ln T_{i,t} = d + \alpha \Delta lnTB_{i,t} + \lambda\left(lnT_{i,t-1} - \beta lnTB_{i,t-1}\right) + vt$

Substituting (2) into (1') gives :

$$\Delta \ln T_{i,t} = d + [\alpha\,\partial]\Delta \ln Y_t + \lambda\left(\ln T_{i,t-1} - [\beta\,\partial]\ln Y_{t-1}\right) + vt$$

The non-linear log form is the following:

$$T_{i,t} = Y_t^{\propto\partial} Y_{t-1}^{-\lambda\beta\delta}$$

- The cyclical adjustment of tax revenue, based on equation (4), using the tax equation both at the current Y level and the potential level Y* is as follows:

(4) $T_{i.t}^* = T_i \left(\frac{Y_t^*}{Y_t}\right)^{\propto\partial} \left(\frac{Y_{t-1}^*}{Y_{t-1}}\right)^{-\lambda\beta\delta}$

The lagged effects apply to the output gap in (t-1) and relate to that part corrected by (λ) in (t) due to the deviation of tax revenues from its long run trend (β) in the preceding year.

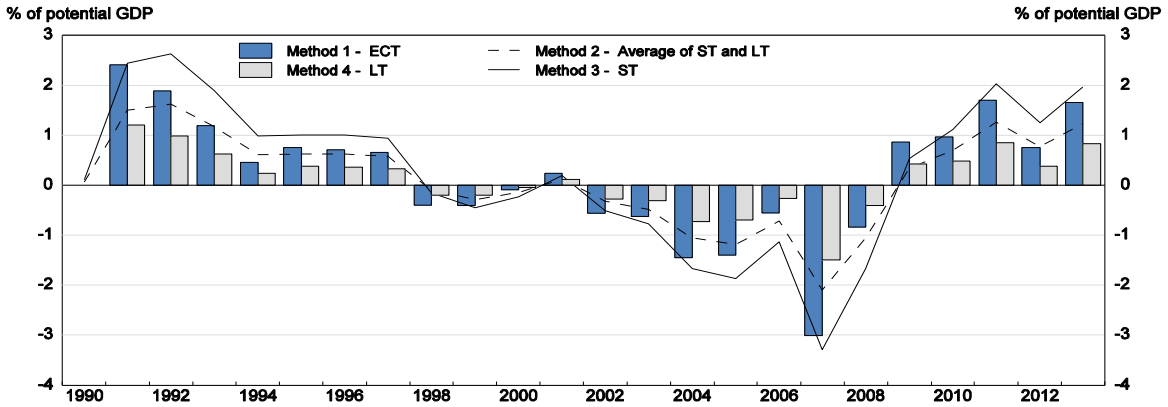
14. While the ECT specification would seem well adapted to account for the actual cyclical behaviour of indirect and corporation taxes -- the short-term elasticity (ST) capturing temporary movements due to cyclical shocks -- the effective elasticity in succeeding years will be a function not just of the short-term elasticity itself but also of the adjustment towards the long-term elasticity (LT). Applying a single short-term elasticity for the purposes of cyclical adjustment may thus actually remove more of the cycle than is actually warranted (where the LT elasticity is below the ST), as is generally the case with the corporate income tax and indirect tax (Tables A1.3 and A1.4). This is illustrated in Figure A1.4. The baseline Method 1 uses the actual ECT equation (4) to arrive at the cyclical adjustment. Using the short-term elasticity ST (Method 3) overstates the adjustment in a large number of years, while using the long-term elasticity LT (Method 4) would understate it. Method 2 applies a cyclical adjustment which is a two-year average of the short-term elasticity in year *t* and the implicit lagged elasticity ($ST + \lambda(ST\text{-}LT)$) in year *t*-1, which would appear to track the baseline more closely than the ST elasticity itself. A three-year average of the compound effect ($ST + \lambda(ST\text{-}LT) + \lambda(ST + \lambda(ST\text{-}LT) - LT)$) tracks the ECT equation even more closely and has been applied for the purposes of cyclical adjustment to both corporate and indirect taxes (Annex Tables A1.3 and A1.4, cols. 1 and 4) where the ECT equation is the preferred specification.

15. The ECT specification is estimated with two others: a first difference Generalised Least Square estimation allowing for a correction of first order AR(1) autocorrelation in the residuals and a specification where the ECT model is controlled for the absence of serial correlation in the residuals (ECT AR(1)). The regression results are presented in Tables A1.3-A1.4. For corporate income tax, the ECT specification is preferred over the first-difference estimate in the majority of cases, while for indirect taxes the first difference specification is preferred in around a third.

16. Model selection is based on several criteria. First, the R^2-adjusted and the statistical significance of the error correction term (lambda) are used to decide whether the ECT model is a better specification than a first-difference model with time-invariant short-term elasticities. Then, in cases where the ECT specification is preferred, the Durbin Watson Statistics is used to confirm the absence of residual autocorrelation and to decide whether the pure ECT or the ECT+AR(1) is preferred. Moreover, the Sum of Errors of the regression is used to ensure the consistency of Student tests and residual normality; and the number of observations is also considered because for some countries time series are sometimes very short or not long enough with respect to the degrees of freedom. If some of these criteria are unsatisfactory, the estimates are considered as not statistically significant (NS). Where the data are missing or the number of observations is too small (fewer than 15 observations) the estimates are set to (NA). In these cases, the elasticities are set to the OECD average.

Figure A1.4. Cyclical adjustment under an ECT model

Adjustment as a percentage of potential GDP



Source: OECD calculations.

Table A1.3. Corporate tax to gross operating surplus regressions

	Corporate tax to gross operating surplus short-term elasticity[1]										Mod1 AR(1), [1]					Mod 2 ECT , [2]							Mod 2 ECT + AR(1) , [3]							N	Dummies
	Tax elasticity	Short term	Long term	3 year average of ST and LT[2]	R^2 adj.	Model[3]	ECT	2nd year	3rd year	3 yr av	dln(gosb)	dln(cit)	R^2 adj.	DW	SE	dln(gosb)	dlm(cit)	ln(tyb $_{t-1}$)	ln(gosb $_{t-1}$)	R^2 adj.	DW	SE	dln(gosb)	dln(cit $_{t-1}$)	ln(tyb $_{t-1}$)	ln(cp $_{t-1}$)	R^2 adj.	DW	SE		
Australia	2.05	2.73	1.25	2.05	0.46	[2]	-0.56	1.90	1.54	2.05	2.54 **	0.54	0.20	1.85	0.09	2.73 **	0.28	-0.56 **	0.71 **	0.46	1.48	0.08	2.73 **	0.25	-0.72	0.90	0.46	1.73	0.08	22	
Austria	1.98	2.77	1.26	1.98	0.42	[2]	-0.67	1.75	1.42	1.98	3.33 **	0.12	0.21	2.15	0.16	2.77 *	-0.14	-0.67 **	0.85 **	0.42	2.10	0.14	2.89 *	-0.10	-0.61	0.76	0.38	1.98	0.14	22	
Belgium	1.76	1.94	1.19	1.76	0.20	[2]	-0.26	1.74	1.60	1.76	2.54 **	1.12	0.18	1.53	0.12	1.94 *	0.44	-0.26	0.31	0.20	2.12	0.11	2.30 *	0.73	-0.19	0.22	0.15	1.50	0.12	22	
Canada	1.00	0.92	1.05	1.00	0.50	[3]	-0.96	1.04	1.05	1.00	1.12 *	0.31	0.24	2.01	0.10	1.30 **	0.47 *	-0.41 *	0.51 *	0.49	0.49	0.49	0.92 **	0.46 **	-0.96 **	1.01 **	0.50	2.10	0.08	22	
Chile	..	..	..	..	..	NA	..	..	..	..	3.49 **	1.13	0.67	1.64	0.20	3.45 **	0.81	-0.14	0.12	0.64	1.44	0.20	3.15 **	0.67	-0.19	0.10	0.61	1.59	0.22	12	
Czech Republic	1.23	1.27	1.11	1.23	0.23	[2]	-0.27	1.22	1.19	1.23	0.88	1.28 *	0.15	2.01	0.11	1.27 *	1.07 *	-0.27	0.30	0.23	1.99	0.11	1.30	1.06	-0.19	0.22	0.08	1.84	0.11	19	
Denmark	2.33	2.58	1.26	2.33	0.52	[3]	-0.20	2.32	2.10	2.33	2.65 **	0.63	0.47	2.06	0.12	2.14 **	0.56	-0.33 *	0.48	0.41	2.39	0.12	2.58 **	0.41	-0.20	0.25	0.52	2.20	0.11	22	
Estonia	..	..	..	..	..	NS	..	..	..	..	0.10	2.59	-0.15	1.36	0.27	-0.58	-0.30	-0.79 **	0.69 *	0.36	1.38	0.20	-0.74	1.19	-0.95 *	0.60 *	0.54	1.90	0.17	12	
Finland	2.12	2.93	0.63	2.12	0.92	[3]	-0.41	1.99	1.44	2.12	4.17 **	0.72	0.42	1.50	0.26	3.20 **	0.81	-0.33 **	0.31	0.72	2.77	0.18	2.93 **	0.68	-0.41 **	0.26 *	0.92	2.21	0.10	19	
France	2.40	2.64	1.98	2.40	0.72	[2]	-0.42	2.37	2.21	2.40	2.23	0.72	0.57	2.08	0.12	2.64 *	0.40	-0.42 **	0.83 **	0.72	1.75	0.09	2.12	0.38	-0.49 *	0.94 *	0.70	1.93	0.10	23	08/09
Germany	1.51	2.15	0.71	1.51	0.51	[2]	-0.55	1.36	1.01	1.51	1.65	0.52 *	0.18	1.88	0.14	2.15 *	0.46 *	-0.55 **	0.39 *	0.51	1.17	0.14	1.56	0.39	-0.53	0.54	0.34	1.94	0.12	22	
Greece	..	..	..	..	..	NS	..	..	..	..	0.57	0.04	-0.10	1.86	0.11	0.10	-0.09	-0.52 *	0.34	0.24	1.86	0.09	0.07	-0.11	-0.71	0.39	0.37	2.41	0.09	17	
Hungary	..	..	..	..	..	NS	..	..	..	..	1.75 **	1.91 *	0.36	1.97	0.17	0.85	1.94 *	-0.16	0.03	0.39	1.67	0.16	-0.13	1.75 *	-0.31	-0.05	0.40	2.07	0.17	17	
Iceland	..	..	..	..	..	NS	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Ireland	0.71	0.69	0.78	0.71	0.54	[2]	-0.23	0.71	0.73	0.71	0.88 *	-0.24	0.38	2.12	0.11	0.69 *	-0.35	-0.23	0.18	0.54	1.94	0.09	0.66 *	-0.37	-0.30	0.25	0.50	1.96	0.10	22	
Israel	..	..	..	..	..	NA	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Italy	1.73	1.75	1.64	1.73	0.33	[3]	-0.12	1.73	1.72	1.73	1.00	1.09 **	0.34	1.90	0.14	0.91	0.71	-0.48 *	0.34 *	0.33	2.20	0.14	1.75 *	1.06 *	-0.12	0.20	0.33	1.95	0.14	22	
Japan	..	..	..	..	..	NA	..	..	..	..	4.08 **	0.78	0.37	1.85	0.18	3.47 **	-0.20	-0.66 *	2.53	0.53	1.63	0.15	3.42 *	-0.49	-0.89	3.79	0.50	1.57	0.17	12	
Korea	..	..	..	..	..	NS	..	..	..	..	0.61	1.23	0.04	2.31	0.11	-0.12	0.26	-0.87 *	0.89 *	0.24	1.36	0.10	-0.89	0.63	-1.37 **	0.90	0.41	1.94	0.09	12	
Latvia	1.89	1.89	..	..	0.59	[1]	0.00	0.00	0.00	0.00	1.89 **	-0.67	0.59	1.69	0.32	1.68 *	-0.01	-0.43	0.45 *	0.38	1.81	0.29	3.56 **	-1.43	-0.11	0.50 *	0.52	1.97	0.26	16	
Luxembourg	..	..	..	..	..	NA	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	6	
Mexico	..	..	..	..	..	NA	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Netherlands	2.20	2.80	0.66	2.20	0.54	[2]	-0.31	2.14	1.68	2.20	2.46 **	-0.29	0.37	1.92	0.11	2.80 **	-0.56	-0.31 **	0.20 *	0.54	1.93	0.09	2.78 **	-0.56	-0.32 *	0.21	0.51	1.97	0.10	22	
New Zealand	1.88	1.99	1.45	1.88	0.43	[2]	-0.22	1.87	1.78	1.88	1.58 *	1.88 *	0.33	1.85	0.10	1.99 **	1.82 *	-0.22	0.32	0.43	1.66	0.09	1.34	1.39	-0.35	0.46	0.38	1.98	0.09	21	
Norway	1.47	1.70	1.27	1.47	0.48	[3]	-0.68	1.41	1.31	1.47	2.16 **	-0.24	0.37	1.99	0.10	2.02 **	-0.11	-0.34	0.46	0.42	1.54	0.10	1.70 **	-0.08	-0.68	0.86	0.48	1.94	0.09	22	
Poland	1.73	1.99	1.13	1.73	0.44	[2]	-0.33	1.70	1.51	1.73	1.59 *	-0.28	0.33	1.85	0.11	1.99 **	-0.20	-0.33 *	0.38 *	0.44	1.65	0.10	1.69 *	-0.25	-0.41	0.40	0.42	1.75	0.10	17	
Portugal	1.54	1.69	1.20	1.54	0.57	[2]	-0.34	1.53	1.41	1.54	2.12 **	0.15	0.58	1.96	0.11	1.69 *	-0.10	-0.34 *	0.41 *	0.57	2.08	0.10	2.00 *	0.10	-0.31 *	0.40	0.53	2.10	0.10	23	93/99
Slovak Republic	1.24	1.33	0.86	1.24	0.74	[2]	-0.21	1.24	1.16	1.24	1.33 **	0.58 **	0.65	2.19	0.06	1.33 **	0.48 **	-0.21	0.18 *	0.74	2.36	0.05	1.28 **	0.56 **	-0.16	0.13	0.73	2.03	0.05	17	
Slovenia	..	..	..	..	..	NA	..	..	..	..	2.30	-1.14	0.39	1.85	0.21	1.38	-1.22	0.10	-0.84	0.51	1.70	0.19	0.01	-2.18	-0.07	-2.93	0.61	2.50	0.17	12	
Spain	1.77	1.77	..	..	0.71	[1]	0.00	0.00	0.00	0.00	1.77 *	-1.65	0.71	1.94	0.11	2.76 **	-2.63	-0.18	0.24	0.60	1.75	0.11	1.47 *	-2.43	-0.15	0.11	0.60	1.95	0.11	22	01/08
Sweden	1.58	1.81	1.42	1.58	0.41	[2]	-0.77	1.51	1.44	1.58	2.87 *	-1.28	0.10	1.44	0.20	1.81 *	1.32 *	-0.77 **	1.09 **	0.41	1.87	0.16	2.03 *	0.13	-0.73	0.95	0.42	1.74	0.16	22	
Switzerland	1.14	0.61	1.77	1.14	0.44	[2]	-0.56	1.26	1.55	1.14	0.73 *	0.06	0.08	1.76	0.07	0.61 *	0.05	-0.56 **	1.00 **	0.44	2.04	0.06	0.63 *	0.08 *	-0.47 **	0.84 **	0.42	1.57	0.06	22	
Turkey	..	..	..	..	..	NA	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
United Kingdom	2.36	2.36	..	..	0.24	[1]	0.00	0.00	0.00	0.00	2.36 *	-0.81	0.24	2.12	0.13	2.18 *	-0.13	-0.22	0.33	0.18	1.21	0.14	1.29	-1.17	-0.52	0.56	0.29	1.97	0.13	22	
United States	3.45	4.74	1.14	3.45	0.59	[3]	-0.42	3.24	2.36	3.45	5.27 **	0.55	0.50	1.87	0.12	5.26 **	0.49	-0.32 *	0.39 *	0.59	1.47	0.11	4.74 **	0.69	-0.42	0.47	0.59	1.84	0.11	22	
OECD[4]	**1.79**	**2.05**	**1.19**	**1.75**	**0.50**		**-0.37**	**1.48**	**1.31**	**1.53**	**2.07**	**0.38**	**0.33**	**1.88**	**0.14**	**1.88**	**0.21**	**-0.39**	**0.48**	**0.46**	**1.76**	**0.14**	**1.71**	**0.11**	**-0.46**	**0.48**	**0.47**	**1.94**	**0.12**		

Key: * Statistically significant at 10% level; ** Statistically significant at 5% level. OECD averages are unweighted averages.

1. Constant, AR(1) and dummies not shown.
2. See Annex for methodology.
3. See Annex for methodology of model selection; (NA) is applied where there are missing data or too few observations; (NS) when estimates are not statistically significant.
4. Average calculated over statistically significant coefficient estimates.

Source: OECD calculations, OECD Economic Outlook 96 database.

Table A1.4. VAT/GST tax to private consumption regressions

	Indirect tax / private consumption short-term elasticity[1]										Mod1 AR(1), [1]						Mod2 ECT, [2]								Mod2 ECT + AR(1), [3]								N	Dummies
	Tax elasticity	Short term	Long term	3 year average of ST and LT[2]	R^2 adj.	Model[3]	ECT	2nd year	3rd year	3 yr av	dln(cp)	dln(vat)	dum09	R^2 adj.	DW	SE	dln(cp)	dlm(vat)	ln(tind $_{t-1}$)	ln(cp $_{t-1}$)	dum09	R^2 adj.	DW	SE	dln(cp)	dln(vat)	ln(tind $_{t-1}$)	ln(cp $_{t-1}$)	dum09	R^2 adj.	DW	SE		
Australia	0.90	1.49	0.70	0.90	0.90	[3]	-1.60	0.22	0.98	0.90	1.07 **	0.00	0.70 **	0.97	1.66	0.01	1.09	0.00	-0.47	0.37	0.56	0.62	2.24	0.02	1.49 **	0.00	-1.60 **	1.11 **	0.18	0.90	2.16	0.01	8	
Austria	..	..	..	..	..	[NS]	..	..	..	..	0.69 *	4.63	0.71	0.36	2.49	0.03	0.36	-2.58	-1.21 **	1.14 **	1.42	0.57	2.26	0.03	0.24	-1.29	-0.72 **	0.67 **	1.10	0.63	2.13	0.02	24	
Belgium	..	..	..	..	..	[NS]	..	..	..	..	0.41	0.82 *	0.87 **	0.55	2.30	0.02	0.61	0.62	-0.22	0.25	0.84 **	0.50	2.35	0.02	0.39	0.72	-0.02	0.02	0.87 **	0.50	2.29	0.02	24	
Canada	1.35	1.54	0.91	1.35	0.50	[2]	-0.35	1.32	1.18	1.35	0.96	0.11	0.71	0.29	1.96	0.03	1.54 *	0.15 *	-0.35 *	0.32 **	0.71	0.50	2.09	0.02	1.65 *	0.21 *	-0.33 *	0.31 *	0.63	0.45	1.97	0.03	20	
Chile	1.33	1.69	1.02	1.33	0.87	[3]	-0.69	1.22	1.08	1.33	0.96 **	0.81	0.80 **	0.84	2.08	0.03	1.45 **	0.89 *	-0.54 *	0.56 *	0.29	0.87	1.73	0.03	1.69 **	0.68	-0.69 *	0.70 *	0.09	0.87	1.92	0.03	16	
Czech Republic	1.10	0.87	1.33	1.10	0.73	[2]	-0.62	1.15	1.26	1.10	0.71	0.09	0.50 *	0.42	2.15	0.04	0.87 *	0.09	-0.62 **	0.82 **	0.51 **	0.73	1.93	0.03	0.86 *	-0.02	-0.88 **	1.21 **	0.52 **	0.74	1.70	0.03	16	
Denmark	0.78	0.78	-	-	0.74	[1]	..	..	..	..	0.78 **	0.01	0.74 **	0.80	1.95	0.01	0.74 **	0.00	0.02	-0.03	0.76 **	0.80	2.13	0.01	0.72 **	-0.02	0.05	-0.07	0.80 **	0.79	2.02	0.01	24	
Estonia	1.35	1.66	1.09	1.35	0.73	[2]	-0.72	1.25	1.14	1.35	1.13 *	1.84	0.74 *	0.50	1.65	0.07	1.66 **	2.99 *	-0.72 **	0.79 **	0.32	0.73	1.99	0.06	1.90 **	2.54 *	-1.36 **	1.57 **	0.27	0.77	1.72	0.05	16	
Finland	0.94	0.89	1.04	0.94	0.86	[3]	-0.43	0.95	0.99	0.94	0.69 *	0.70 **	0.40	0.76	2.35	0.01	0.83 **	0.59 *	-0.77 **	0.76 **	0.21	0.88	1.57	0.01	0.89 **	0.49 *	-0.43 *	0.44 *	0.39	0.86	2.13	0.01	17	01/10
France	0.81	0.81	-	-	0.80	[1]	..	..	..	..	0.81 **	0.27 *	0.80	0.85	2.07	0.01	0.53 *	0.32 **	0.12	-0.11	0.88 **	0.85	2.66	0.01	0.75 **	0.31 **	0.10	-0.09	0.82 **	0.86	2.11	0.01	24	94/96/01
Germany	0.92	0.89	1.92	0.92	0.83	[3]	-0.03	0.92	0.96	0.92	0.66 *	1.04 **	0.82 **	0.84	2.09	0.02	0.83 *	0.83 **	-0.10	0.15	0.84 *	0.78	2.59	0.02	0.89 *	1.02 **	-0.03	0.07	0.78 **	0.83	2.13	0.02	24	
Greece	1.06	1.06	..	..	0.56	[1]	..	..	..	..	1.06 **	0.92 **	0.56 **	0.87	1.91	0.04	1.09 **	0.79 **	-0.16	0.18	0.51 **	0.86	1.74	0.04	1.12 **	0.84 **	-0.18	0.20	0.49 **	0.86	1.86	0.04	23	
Hungary	1.16	1.16	..	..	0.31	[1]	..	..	..	..	1.16 **	0.97 **	0.31 *	0.84	2.25	0.03	0.86 *	0.55 *	-0.61 **	0.68 **	0.05	0.84	1.49	0.05	0.99 **	0.90 **	-0.06	0.05	0.25	0.82	2.14	0.03	20	
Iceland	1.13	1.24	0.93	1.13	0.87	[3]	-0.43	1.11	1.03	1.13	0.51	0.71	0.87	0.81	1.96	0.03	1.11 **	0.27	-0.90 **	0.33 *	0.52 *	0.88	1.78	0.02	1.24 **	0.54	-0.43 **	0.40 *	0.45 *	0.87	2.06	0.02	20	99/06
Ireland	1.11	1.11	..	..	0.78	[1]	..	..	..	..	1.11 **	0.58 **	0.78 **	0.65	2.38	0.02	1.14 **	0.64 **	-0.03	0.02	0.65 **	0.93	2.78	0.02	1.09 **	0.71 **	0.00	-0.02	0.72 **	0.94	2.52	0.02	24	
Israel	0.91	1.00	0.84	0.91	0.60	[2]	-0.69	0.89	0.85	0.91	0.90 **	0.39 *	0.17	0.46	2.07	0.03	1.00 **	0.43 *	-0.69 *	0.58 *	-0.12	0.60	2.22	0.02	1.03 **	0.42 *	-0.46	0.39	-0.06	0.59	2.17	0.02	16	
Italy	1.11	1.11	..	..	0.77	[1]	..	..	..	..	1.11 **	-0.65	0.77 **	0.57	2.06	0.04	1.74 **	-0.81	-0.92 **	1.06 **	0.19	0.67	1.68	0.04	2.42 **	-0.69 *	-1.39 **	1.62 **	-0.01	0.69	1.38	0.04	24	
Japan	..	..	..	..	..	[NS]	..	..	..	..	..	..	..	..	..	..	1.24	-0.12	-0.38 **	2.91 *	0.65	0.34	1.09	0.07	2.26	-0.11	-0.43 **	5.56 *	1.46	0.52	1.24	0.06	21	
Korea	1.46	1.63	1.26	1.46	0.90	[3]	-0.56	1.42	1.33	1.46	1.19 **	0.00	1.10 **	0.78	2.19	0.04	1.60 **	0.00	-0.34 *	0.42 *	0.55	0.83	2.16	0.04	1.63 **	0.00	-0.56 *	0.71 *	0.44	0.90	2.05	0.03	20	
Latvia	..	..	..	..	..	[NA]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Luxembourg	..	..	..	..	..	[NS]	..	..	..	..	0.15	0.17	0.50 *	-0.01	2.03	0.03	0.47	0.31	0.07	-0.09	0.31	-0.06	1.93	0.03	0.37	0.26	0.04	-0.05	0.37	-0.12	2.01	0.04	24	
Mexico	1.17	1.17	..	..	0.24	[1]	..	..	..	..	1.17 **	0.03	0.24	0.88	1.61	0.04	1.04 **	0.05	-0.13	0.13	0.59 *	0.87	1.93	0.05	0.82 **	0.24	-0.04	0.02	0.55 *	0.89	1.79	0.04	24	92/03
Netherlands	1.00	0.94	1.29	1.00	0.69	[2]	-0.20	1.01	1.07	1.00	0.96 **	0.31	0.62 **	0.63	1.79	0.03	0.94 **	0.13	-0.20	0.26 *	0.61 **	0.69	2.14	0.02	1.12 **	0.02	-0.14	0.20 *	0.54 **	0.71	1.72	0.02	23	
New Zealand	1.32	1.34	1.28	1.32	0.67	[2]	-0.29	1.32	1.31	1.32	1.14 **	0.28 *	0.50	0.41	1.95	0.03	1.34 **	0.35 **	-0.29 *	0.38 *	0.50 **	0.67	2.06	0.02	1.61 **	0.48 **	-0.22 *	0.29 *	0.60 **	0.68	1.48	0.02	17	01/10
Norway	..	..	..	..	..	[NS]	..	..	..	..	-1.97 *	0.18	0.94 **	0.36	2.09	0.04	-1.68 *	0.16	-0.21	0.19	0.95 **	0.45	2.17	0.04	-1.68 *	0.16	-0.21	0.19	0.95 **	0.41	2.17	0.04	24	
Poland	0.96	0.96	..	..	1.03	[1]	..	..	..	..	0.96 **	0.00	1.03 **	0.47	2.00	0.04	1.42 *	0.48	-0.34	0.38	0.85 *	0.59	2.02	0.05	1.18	-0.14	-0.13	0.16	1.01 **	0.35	1.98	0.05	15	
Portugal	0.97	0.97	..	..	0.85	[1]	..	..	..	..	0.97 **	1.21 **	0.85 **	0.76	2.32	0.05	1.29 *	0.83	-0.35 *	0.49 *	0.57 *	0.60	2.67	0.06	0.90 **	1.19 **	-0.03	0.03	0.79 **	0.74	2.29	0.05	24	
Slovak Republic	1.22	1.44	0.95	1.22	0.80	[2]	-0.54	1.18	1.05	1.22	0.81 **	0.51	0.51	0.78	2.70	0.04	1.44 **	0.39	-0.54 **	0.51 **	0.36 *	0.80	2.16	0.03	1.27 **	0.70 *	-0.32 *	0.30 *	0.30	0.82	2.47	0.03	17	01/10
Slovenia	0.98	0.98	..	..	0.76	[1]	..	..	..	..	0.98 **	0.67 *	0.76 **	0.72	2.14	0.03	1.27 *	0.78 *	-0.32	0.34	0.43 *	0.63	2.28	0.04	0.95 *	0.46	-0.18	0.15	0.74 **	0.70	2.37	0.03	12	
Spain	1.82	1.82	..	..	0.81	[1]	..	..	..	..	1.82 **	-0.64 **	0.81 **	0.80	1.93	0.05	2.29 **	-0.06	-0.51 **	0.65 **	0.57 **	0.84	1.35	0.05	3.35 **	-0.21	-0.68 **	0.01	0.28 *	0.91	2.07	0.04	24	
Sweden	1.49	1.49	..	..	1.25	[1]	..	..	..	..	1.49 *	2.18 *	1.25 **	0.57	2.20	0.05	2.25 **	0.55	-0.71 **	0.97 **	0.69	0.56	2.30	0.05	2.03 **	1.89	-0.22	0.34	1.35 **	0.62	2.27	0.05	24	
Switzerland	..	..	..	..	..	[NS]	..	..	..	..	-0.17	0.29	1.72 **	0.61	2.52	0.03	0.31	0.22	-0.13	0.19	1.14 *	0.44	2.04	0.03	0.49	0.15	-0.31	0.37	0.99 *	0.62	2.80	0.02	16	
Turkey	1.45	1.89	1.12	1.45	0.92	[3]	-0.78	1.29	1.16	1.45	..	..	..	..	..	..	1.86 **	0.55 *	-0.75 **	0.84 **	0.34	0.92	1.61	0.08	1.89 **	0.51 *	-0.78 **	0.87 **	0.32	0.92	1.85	0.08	24	
United Kingdom	1.56	1.75	1.11	1.56	0.81	[2]	-0.33	1.53	1.39	1.56	1.14 **	0.79 **	0.68	0.73	2.05	0.03	1.75 **	0.65 **	-0.33 *	0.37 **	0.52	0.81	2.20	0.03	1.78 **	0.68 **	-0.30 *	0.34 *	0.57	0.80	2.03	0.03	24	
United States	..	..	..	..	..	[NA]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
OECD[4]	**1.16**	**1.25**	**1.12**	**1.20**	**0.76**		**-0.55**	**1.12**	**1.12**	**1.20**	**0.82**	**0.62 #**	**0.73**	**0.64**	**2.09**	**0.03**	**1.10**	**0.34**	**-0.41**	**0.51**	**0.57**	**0.68**	**2.04**	**0.03**	**1.19**	**0.41**	**-0.39**	**0.55**	**0.59**	**0.71**	**2.03**	**0.03**		

Key: * Statistically significant at 10% level; ** Statistically significant at 5% level. OECD averages are unweighted averages.

1. Constant, AR(1) and dummies not shown.
2. See Annex for methodology.
3. See Annex for methodology of model selection; (NA) is applied where there are missing data or too few observations; (NS) when estimates are not statistically significant.
4. Average calculated over coefficient estimates statistically significant.

Source: OECD calculations, OECD Economic Outlook 96 database, OECD Revenue Statistics.

Table A1.5. Non-tax revenue elasticities

	e(ntax,y)	R^2 adjusted	Durbin Waston	Standard Error
Australia	-0.48	-0.04	2.11	0.08
Austria	-0.29	-0.09	1.98	0.08
Belgium	0.06	-0.09	1.94	0.05
Canada	1.44 **	0.34	2.10	0.04
Chile	..	..	..	..
Czech Republic	-0.55	-0.01	1.93	0.05
Denmark	0.39	-0.06	1.97	0.07
Estonia	0.11	-0.24	1.97	0.09
Finland	-0.06	-0.09	2.04	0.07
France	0.34	-0.07	1.99	0.04
Germany	0.26	0.11	2.18	0.05
Greece	0.89	-0.02	1.78	0.11
Hungary	-0.29	-0.03	2.33	0.07
Iceland	0.66	-0.08	2.00	0.19
Ireland	-0.60	0.03	2.02	0.06
Israel	-0.05	-0.14	1.66	0.09
Italy	0.23	0.13	2.22	0.04
Japan	0.31	0.21	1.39	0.05
Korea	0.30	-0.06	1.98	0.07
Latvia	0.25	0.35	1.60	0.09
Luxembourg	1.36	0.18	1.79	0.06
Mexico	1.36	0.18	1.79	0.06
Netherlands	0.90	-0.02	2.00	0.06
New Zealand	0.83	-0.05	1.97	0.08
Norway	2.93	-0.04	2.01	0.19
Poland	-1.99	-0.05	1.64	0.09
Portugal	1.17	-0.05	2.03	0.11
Slovak Republic	-1.69	0.20	1.83	0.17
Slovenia	0.98	-0.13	1.99	0.07
Spain	-1.84	-0.01	2.12	0.09
Sweden	0.49	0.06	2.33	0.04
Switzerland	0.21	0.00	2.15	0.04
Turkey	0.21	0.00	2.15	0.04
United Kingdom	0.73	-0.06	1.43	0.10
United States	0.05	-0.06	1.60	0.03
OECD[2]	**0.28**	**0.01**	**1.94**	**0.08**

Key: * Statistically significant at 10% level; ** Statistically significant at 5% level. OECD averages are unweighted averages.

1. Constant, AR(1) and dummies not shown.
2. Average calculated over statistically significant coefficient estimates.

Source: OECD calculations, OECD Economic Outlook 96 database.

III. ESTIMATING TAX BASE/OUTPUT GAP ELASTICITIES

17. In the case of direct taxes, the tax bases/output gap elasticities are estimated from time series data. In the 2005 model, this concerns only the elasticity of wages and salaries (WSSS) with respect to gap, WSSS aggregate being taken as the base for personal income tax. The corporate income tax base/output gap elasticity is then defined as the reciprocal of the WSSS/gap elasticity on the basis that GDP minus WSSS approximates to the gross operating surplus (although it also comprises income from self-employment). In the new model, the three GDP income components, WSSS, self-employment income (YSE) and the gross operating surplus (GOS), are identified separately. In addition, the fact that the income tax base also includes capital income (YPE) is taken into account. Transfer incomes are not separately identified as part of the tax base.[5]

18. In order to remedy non-stationarity problems, the tax base/output gap models are specified in first difference form, the results being interpreted as short-run elasticities. Three specifications have been tested: *i)* a Generalised Least Square estimation allowing for a correction of first order AR(1) autocorrelation in the residuals, following the 2005 model; *ii*) an error-correction model and *iii)* a specification which combines both corrections, where the error correction term model is controlled for the absence of serial correlations in the residuals (ECT AR(1)). Though serial correlation does not affect consistency of the estimated regression coefficients, it does affect the ability to conduct valid statistical tests. An approach based on an ECT specification allows the estimation of short-run elasticities taking into account a time-varying correction term which measures the past-year deviation of the current level relative to the predicted long-run equilibrium value (or long run growth rate). The model takes the following form:

$$\Delta ln(B_t / Y^*_t) = c + \alpha \Delta ln(Y_t / Y^*_t) + \lambda(lnB_{t-1} / Y^*_{t-1}) - \beta ln(Y_{t-1}/Y^*_{t-1})) + u_t \qquad \text{(A3)}$$

where B is the tax base, Y is output and Y^* potential output, α is the short-run elasticity (relevant to the cyclical adjustment process), β is a long-run elasticity and the lags are captured by the error correction term (ECT) λ, which describes how much of the past deviation from long-term trend in $t-1$ is corrected in time t. The lags are controlled in order to get the best estimate for the short-term elasticity. The lower the value of λ, the slower the speed of adjustment from past disequilibrium.

19. The following Tables (Tables A1.6 – A1.9) show the direct tax bases-to-output elasticity estimates selected from the three specifications. The best model has been selected following the process described above. Equations have been estimated for each individual country and each individual variable for which enough time series data are available (1990 to 2013). Annual dummies were required for some countries and some regressions on a case-by-case basis in order to stabilise the estimates. The earnings/output gap elasticities range from around 0.5 to 1.5, which is similar to the range in the 2005 model, with an average of around 0.84; however, the ECT approach results in higher, more consistent and more statistically significant coefficient estimates compared to the 2005 approach and is preferred in almost every case. The ECT (λ) coefficients are shown to indicate whether the ECM is better than an AR first difference model, which is the case if λ is statistically significant. The value of λ is less important, but an average of around -0.07, indicates a rather slow

5. Transfers in aggregate have a zero or negative elasticity with respect to the gap but where they are untaxed do not form part of the tax base. However, data on taxable transfers are not available and since using total transfers are not a useful proxy for the weight of transfer incomes in the tax base, the approach used has been to exclude transfer incomes from the model, to prevent a downward bias in the elasticity estimates. Transfers are thus implicitly taken as reacting to the output gap in the same way as the average of other incomes (as is the case in the 2005 model), which may slightly overstate the elasticity in some cases.

speed of adjustment from disequilibria. In the 2005 exercise, statistical, geographical and economic criteria were used to split the elasticity results into 7 sub-groups for which it seemed reasonable to estimate a common coefficient using panel estimation techniques. That approach has not been used here. In part, this is dictated by the fact that the ECM has been used to estimate elasticities for self-employment income and for gross operating surplus and by the fact that these have to be consistent with one another, which makes a sub-grouping of WSSS coefficients problematic.

20. The basic income-based GDP identity implicitly requires that the (weighted) elasticities for gross operating surplus, wage-salaries and self-employment incomes should sum up to one. As such, the freely estimated elasticities derived from the WSSS, YSE and GOS output gap regressions need to be constrained to sum to unity. Discrepancies caused by the elasticities not summing to one are allocated proportionally to the size of the respective model errors. This implies a minimal adjustment in cases where the weighted sum of tax base components is already close to one. In the remaining cases, no adjustments are applied to the derived estimates where the model results are good, implying few estimation errors, which largely applies to the elasticities of wages and salaries. The adjustments are thus made for the most part to the gross operating surplus and self-employment elasticities, where these are statistically significant. More concretely, in order to keep the weighted sum of tax base components to unity, while holding unchanged the output wage elasticity, both other elasticities are adjusted by β, where:

$$\beta = \left(\frac{\varepsilon_{yse,y}.w_{yse}+\varepsilon_{gos,y}.w_{gos}}{1-\varepsilon_{wsss,y}.w_{swsss}}\right) \tag{A4}$$

with ε_i and w_i being, respectively, the estimated elasticities and weights of i = WSSS, YSE and GOS. When the freely estimated data are missing (NA) or not statistically significant (NS), the elasticities are set conventionally to the OECD average and adjusted accordingly (Table A1.10), except in cases where the elasticities for self-employment income are not statistically significant and where the hypothesis that the coefficient set to the OECD average (1.46) can be statistically rejected.

21. The data used for the econometric analysis are mainly drawn from the latest *OECD Economic Outlook 96* and *OECD Analytical Data Base*. Output gaps have been revised compared to previous *OECD Economic Outlook* versions, explaining some significant departures in the estimates for a number of OECD countries. To the same extent, any comparison with preceding or similar EU work requires some caution insofar as the source or the version of output gaps differs. Unemployment[6] benefits and earning-related[7] benefits time series for OECD countries are drawn from the *OECD Social Expenditures*[8] Data Base.

6. Unemployment benefit spending includes public spending on compensation pay and early retirement for labour market reasons.

7. Earning-related benefit spending covers family, housing and other social benefits, which are in most cases earning related and means-tested.

8. Latest year available for all OECD countries is 2011.

Table A1.6. Wage and salaries to output gap estimations

	Wage and salaries to output gap short-term elasticity[1]			Model AR(1), [1]				Model ECT, [2]						Model ECT+AR(1), [3]						N	Dummies
	e(wsss,y)	R^2 adj.	Model[2]	dln(y)	R^2 adj.	DW	SE	dln(y)	ln(wsss $_{t-1}$)	ln(y $_{t-1}$)	R^2 adj.	DW	SE	dln(y)	ln(wsss $_{t-1}$)	ln(y $_{t-1}$)	R^2 adj.	DW	SE		
Australia	1.03 **	0.31	[2]	0.91 *	0.22	1.75	0.02	1.03 **	-0.01	0.76 **	0.31	1.72	0.02	1.22 **	-0.01	0.77 *	0.33	1.93	0.02	24	90/10
Austria	0.77 **	0.74	[3]	0.46 **	0.60	1.46	0.01	0.52 *	-0.05	0.34	0.23	0.40	0.01	0.77 **	0.01	0.61 **	0.74	1.72	0.01	24	
Belgium	0.63 **	0.79	[3]	0.09	0.39	1.55	0.01	0.62 **	-0.02 *	1.12 **	0.80	2.12	0.80	0.63 **	-0.02 *	1.13 **	0.79	1.98	0.01	24	94/96/99
Canada	0.89 **	0.63	[3]	0.63 **	0.40	1.89	0.01	0.85 **	0.00	0.61 **	0.63	1.67	0.01	0.89 **	0.00	0.62 **	0.63	1.97	0.01	24	
Chile	0.68	0.43	[2]	0.50	0.16	1.86	0.02	0.68 **	0.04 *	0.55 *	0.43	1.74	0.02	0.66 *	0.04	0.52 *	0.36	1.76	0.02	16	01
Czech Republic	0.84 **	0.67	[2]	0.78 **	0.53	1.80	0.02	0.84 **	-0.14 **	0.41 **	0.67	1.51	0.02	0.86 **	-0.11 *	0.33	0.62	1.75	0.02	16	
Denmark	0.54 **	0.74	[3]	0.32 *	0.38	1.57	0.01	0.51 **	-0.03 *	0.49 **	0.74	1.47	0.01	0.54 **	-0.03 *	0.51 **	0.74	1.91	0.01	24	00
Estonia	1.49 **	0.95	[3]	0.93 *	0.57	1.26	0.06	1.31 **	-0.01	0.84 **	0.95	1.49	0.02	1.49 **	0.09	0.93 **	0.95	2.07	0.02	11	
Finland	0.70 **	0.85	[3]	0.36 *	0.67	2.04	0.02	0.66 **	-0.01	0.51 **	0.84	1.43	0.84	0.70 **	-0.03	0.58 **	0.85	1.97	0.01	24	94/96/99
France	0.73 **	0.83	[3]	0.48 **	0.59	1.66	0.01	0.74 **	-0.01 *	0.48 **	0.83	1.49	0.00	0.73 **	-0.01	0.48 **	0.83	1.83	0.00	24	
Germany	0.54 **	0.68	[3]	0.36 **	0.48	1.49	0.02	0.50 *	-0.14 *	0.42 *	0.43	0.58	0.02	0.54 **	-0.33	0.61 **	0.68	1.55	0.01	24	
Greece	0.73 **	0.92	[3]	0.14	0.84	1.52	0.03	0.88 **	-0.12 **	0.70 **	0.92	1.74	0.02	0.73 **	-0.12 **	0.72 **	0.92	1.89	0.02	24	02/95
Hungary	0.87 **	0.84	[2]	0.95 **	0.70	2.20	0.03	0.87 **	-0.13 **	0.17	0.84	1.79	0.02	0.89 *	-0.13 **	0.16	0.78	1.83	0.02	17	
Iceland	0.88 **	0.28	[1]	0.88 **	0.28	2.02	0.04	1.09 **	-0.04	0.36	0.31	1.73	0.04	1.05 **	-0.04	0.36	0.28	1.96	0.04	24	94/96/99
Ireland	0.74 **	0.67	[3]	0.63 *	0.54	1.70	0.03	0.81 **	-0.08 *	0.41 **	0.65	1.21	0.03	0.74 **	-0.09 *	0.45 **	0.67	1.65	0.02	24	
Israel	0.88 **	0.87	[3]	0.49 *	0.73	1.76	0.02	1.16 **	-0.19 **	1.01 **	0.85	1.64	0.01	0.88 **	-0.47 **	1.13 **	0.87	1.98	0.01	24	90/10
Italy	0.57 **	0.81	[3]	0.34 *	0.71	1.73	0.01	0.44 **	-0.03 *	0.46 **	0.79	1.74	0.79	0.57 **	-0.02	0.54 **	0.81	1.97	0.01	24	94/96/99
Japan	0.82 **	0.78	[3]	0.45 **	0.56	2.22	0.01	0.88 **	0.00	0.72 **	0.76	1.43	0.01	0.82 **	-0.02	0.71 **	0.78	2.08	0.01	24	
Korea	1.31 **	0.85	[2]	0.71 **	0.71	1.67	0.03	1.31 **	-0.10 **	0.99 **	0.85	1.90	0.02	1.27 **	-0.10 **	0.97 **	0.84	1.92	0.02	24	92/97/98
Latvia	..	..	na	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..		
Luxembourg	0.68 **	0.69	[3]	0.36 *	0.39	1.46	0.02	0.63 **	0.02	0.45 **	0.69	1.40	0.01	0.68 **	0.03	0.50 **	0.69	1.81	0.01	17	
Mexico	0.88 **	0.96	[3]	0.62 **	0.93	1.51	0.02	0.90 **	-0.14 **	0.63 **	0.95	0.67	0.02	0.88 **	-0.14 **	0.66 **	0.96	1.79	0.01	17	
Netherlands	0.71 **	0.78	[3]	0.35	0.33	1.24	0.01	0.74 **	-0.03 *	0.80 **	0.74	1.12	0.01	0.71 **	-0.04 *	0.86 **	0.78	1.66	0.01	24	
New Zealand	0.64 *	0.49	[3]	0.29	0.41	1.75	0.02	0.88 **	0.03	0.55 **	0.46	1.41	0.02	0.64 *	0.02	0.55 *	0.49	1.77	0.01	23	
Norway	1.16 **	0.70	[3]	0.69 *	0.38	1.63	0.02	1.16 **	0.00	0.78 **	0.71	1.61	0.01	1.16 **	0.00	0.80 **	0.70	1.78	0.01	24	
Poland	1.42 **	0.73	[3]	0.38	0.40	2.14	0.03	1.79 **	-0.26 **	2.35 **	0.82	1.32	0.02	1.42 **	-0.20 **	2.20 **	0.73	2.19	0.02	16	90/10
Portugal	1.07 **	0.85	[3]	0.81 **	0.75	1.26	0.03	1.09 **	-0.11 **	0.65 **	0.84	1.09	0.02	1.07 **	-0.12 **	0.59 *	0.85	1.25	0.02	24	
Slovak Republic	0.67 **	0.57	[3]	0.55 *	0.24	2.04	0.02	0.73 **	-0.14 **	0.22	0.64	2.64	0.02	0.67 **	-0.11 **	0.14	0.57	2.48	0.02	16	00
Slovenia	0.65 **	0.93	[2]	0.59 **	0.73	1.26	0.02	0.65 **	-0.19 **	0.60 **	0.93	1.87	0.01	0.77 **	-0.15 *	0.59 **	0.92	1.87	0.01	12	
Spain	0.86 **	0.76	[1]	0.86 **	0.76	1.74	0.02	1.14 **	-0.08 **	0.85 **	0.91	1.58	0.01	1.14 **	-0.08 **	0.85 **	0.91	1.59	0.01	24	
Sweden	0.77 **	0.60	[3]	0.47 *	0.48	1.93	0.02	0.76 **	-0.03	0.52 **	0.60	1.58	0.02	0.77 **	-0.04	0.62 **	0.60	1.98	0.02	24	90/10
Switzerland	0.69 **	0.85	[2]	0.01	0.34	1.56	0.02	0.69 **	-0.09 **	1.07 **	0.85	1.88	0.01	0.67 **	-0.09 **	1.08 **	0.84	1.95	0.01	24	
Turkey	..	..	na	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0	
United Kingdom	0.61 **	0.50	[3]	0.41 *	0.46	1.77	0.01	0.53 *	-0.04 *	0.54 **	0.39	1.15	0.01	0.61 **	-0.03	0.44 *	0.50	1.85	0.01	24	90/10
United States	1.18 **	0.74	[3]	1.08 **	0.65	1.65	0.01	1.15 **	-0.04 *	0.27 **	0.74	1.43	0.01	1.18 **	-0.04 *	0.31 *	0.74	1.69	0.01	24	90/10
OECD[3]	**0.84**	**0.72**		**0.54**	**0.52**	**1.70**	**0.02**	**0.86**	**-0.07**	**0.65**	**0.70**	**1.50**	**0.09**	**0.86**	**-0.07**	**0.68**	**0.72**	**1.86**	**0.01**		

Key: * Statistically significant at 10% level; ** Statistically significant at 5% level. OECD averages are unweighted averages.

1. Constant, AR(1) and dummies not shown.
2. See Annex for methodology of model selection; (NA) is applied where there are missing data or too few observations; (NS) when estimates are not statistically significant.
3. Average calculated over coefficient estimates statistically significant.

Source: OECD calculations, OECD Economic Outlook 96 database.

Table A1.7. Self-employment income to output gap regressions

	Self-employed income to output short-term elasticity[1]			Model AR(1), [1]				Model ECT, [2]						Model ECT+AR(1), [3]						N	Dummies
	e(yse,y)	R^2 adj.	Model[2]	dln(y)	R^2 adj.	DW	SE	dln(y)	ln(yse $_{t-1}$)	ln(y $_{t-1}$)	R^2 adj.	DW	SE	dln(y)	ln(yse $_{t-1}$)	ln(y $_{t-1}$)	R^2 adj.	DW	SE		
Australia	..	..	NS	0.79	-0.05	2.08	0.05	1.38	0.01	0.99	-0.01	2.33	0.05	1.19	0.01	1.01	-0.03	2.22	0.05	24	
Austria	1.05	0.56	[1]	1.05 **	0.56	2.01	0.02	0.84 **	-0.02	-0.09	0.52	1.82	0.02	1.00 **	-0.02	-0.04	0.51	2.00	0.02	24	02/04
Belgium	1.13	0.65	[3]	1.29 **	0.50	1.74	0.02	1.08 **	-0.29 **	-0.18	0.65	1.45	0.02	1.13 **	-0.34 *	-0.07	0.65	1.83	0.02	24	02/04
Canada	..	..	NS	0.17	0.04	2.19	0.01	0.10	-0.01	0.08	-0.13	1.57	0.01	0.20	0.00	0.06	-0.06	2.18	0.01	24	
Chile	1.42	0.86	[3]	1.65 **	0.68	1.34	0.03	1.74 **	-0.20 *	0.09	0.76	1.78	0.03	1.42 **	-0.43	0.27	0.86	1.42	0.02	16	
Czech Republic	..	..	NS	-0.47 *	0.59	2.35	0.02	-0.01	-0.29 **	0.12	0.48	0.97	0.02	-0.18	-0.47	0.17	0.58	1.51	0.02	16	
Denmark	..	..	NS	0.00	-0.09	1.92	0.07	-0.05	-0.22 *	-1.31 *	0.21	2.15	0.06	-0.05	-0.19 *	-1.32 **	0.19	1.98	0.06	24	
Estonia	1.33	0.84	[1]	1.33 **	0.84	1.86	0.04	1.29 **	-0.41	0.59	0.86	1.71	0.04	1.24 **	-0.90	1.27	0.84	1.60	0.04	11	
Finland	..	..	NS	0.01	0.04	2.10	0.03	0.28	-0.07	0.15	-0.01	2.82	0.03	0.16	-0.06 *	0.17	0.15	2.01	0.03	24	
France	1.69	0.60	[2]	1.62 **	0.44	2.01	0.02	1.69 **	-0.10 **	0.61 *	0.60	1.97	0.02	1.67 **	-0.10 **	0.60 *	0.58	1.92	0.02	24	
Germany	1.76	0.37	[1]	1.76 **	0.37	1.96	0.05	1.90 **	-0.16	0.59	0.40	1.89	0.04	1.97 **	-0.20	0.61	0.38	1.97	0.05	24	
Greece	1.26	0.54	[1]	1.26 **	0.54	2.05	0.03	1.08 **	-0.09	-0.03	0.57	2.17	0.03	1.19 **	-0.05	-0.07	0.52	2.00	0.03	17	
Hungary	0.86	0.68	[2]	1.19 *	0.23	2.29	0.05	0.86 *	-0.28 **	0.28	0.68	2.38	0.04	0.85 *	-0.22 **	0.06	0.53	2.34	0.04	17	01/06
Iceland	..	..	NA	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Ireland	..	..	NS	-0.20	0.62	2.15	0.05	-0.01	-0.26 *	0.29	0.63	2.33	39.91	-0.08	-0.19	0.20	0.62	2.12	0.05	24	09
Israel	..	..	NA	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Italy	0.71	0.52	[2]	0.77 **	0.29	2.14	0.02	0.71 **	-0.08 **	0.26	0.52	2.21	0.02	0.68 **	-0.08 **	0.28	0.51	2.02	0.02	24	
Japan	..	..	NS	-0.23	-0.07	2.00	0.03	-0.05	-0.04	0.36	-0.06	2.12	0.03	-0.08	-0.04	0.37	-0.11	2.01	0.04	24	
Korea	..	..	NS	-0.10	-0.06	2.09	0.05	-0.24	-0.11	-0.21	-0.08	1.53	0.05	-0.27	-0.22	-0.50	-0.06	2.25	0.05	24	
Latvia	..	..	NS	0.62	0.00	2.41	0.15	0.47	-0.13	-0.56	-0.10	2.20	0.17	0.41	-0.12	-0.47	-0.12	2.39	0.16	14	
Luxembourg	..	..	NA	1.86 **	0.72	2.18	0.04	0.70	-0.31	-0.54 **	0.10	2.41	0.06	2.45 **	-0.57	2.70 **	0.97	2.16	0.01	6	
Mexico	..	..	NA	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Netherlands	4.54	0.50	[1]	4.54 **	0.50	1.85	0.07	4.29 **	-0.12	-0.61	0.54	1.84	0.07	4.50 **	-0.16	-0.40	0.52	1.95	0.07	24	09/10/12
New Zealand	..	..	NS	0.78	-0.01	2.00	0.06	0.77	-0.17	0.74	-0.03	1.19	0.07	1.01	-0.67 *	2.48 *	0.21	2.09	0.06	22	
Norway	..	..	NS	0.17	0.06	2.29	0.04	-0.38	-0.35 *	-0.84 **	0.21	1.54	0.03	-0.10	-0.46	-0.73	0.24	2.01	0.03	24	
Poland	1.19	0.76	[3]	0.68	-0.03	1.92	0.04	1.12 *	-0.18 **	1.47	0.63	2.96	0.03	1.19 **	-0.20 **	1.29 **	0.76	1.90	0.02	16	
Portugal	..	..	NS	0.65	0.16	2.27	0.04	0.57	-0.13 **	0.10	0.46	2.19	0.03	0.56	-0.13 **	0.15	0.45	1.99	0.04	24	
Slovak Republic	0.91	0.53	[1]	0.91 **	0.53	1.83	0.04	0.80 *	-0.10 **	-0.15	0.49	1.16	0.04	1.24 **	-0.40	1.04	0.72	2.09	0.03	16	
Slovenia	..	..	NA	1.21 *	0.32	1.99	0.05	1.46 **	-0.62 **	1.73	0.80	2.84	0.03	1.53 **	-0.73 **	1.95 **	0.94	2.01	0.02	12	
Spain	1.20	0.50	[2]	1.31 **	0.50	1.66	0.03	1.20 *	-0.10	-0.06	0.50	1.68	0.03	1.05 *	-0.05	-0.01	0.38	1.03	0.03	24	10
Sweden	1.01	0.36	[2]	1.31 **	0.15	1.92	0.05	1.01 *	-0.35 **	-0.22	0.36	1.49	0.05	1.23 *	-0.51	0.06	0.40	1.97	0.05	24	
Switzerland	..	..	NS	0.21	0.03	2.01	0.02	0.05	-0.20 *	-0.14	0.07	1.33	0.02	0.16	-0.30	-0.17	0.13	1.94	0.02	24	
Turkey	..	..	NA	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
United Kingdom	1.67	0.33	[2]	1.05	0.03	1.80	0.07	1.67 *	-0.15 **	-0.37	0.33	2.32	0.06	0.81	-0.12 **	-0.47	0.38	1.88	0.05	24	92/10
United States	1.69	0.67	[1]	1.69 **	0.67	2.01	0.03	1.65 **	-0.02	-0.30	0.70	2.54	0.70	1.53 **	-0.02	-0.45	0.73	2.12	0.02	24	09/10/12
OECD[3]	**1.46**	**0.58**	**0.00**	**0.93**	**0.29**	**2.01**	**0.04**	**0.90**	**-0.18**	**0.09**	**0.38**	**1.96**	**1.35**	**0.96**	**-0.26**	**0.32**	**0.43**	**1.96**	**0.04**		

Key: * Statistically significant at 10% level; ** statistically significant at 5% level. OECD averages are unweighted averages.

1. Constant, AR(1) and dummies not shown.
2. See Annex for methodology of model selection; (NA) is applied where there are missing data or too few observations; (NS) when estimates are not statistically significant.
3. Average calculated over coefficient estimates statistically significant.

Source: OECD calculations, OECD Economic Outlook 96 database.

Table A1.8. Corporate income tax base to output gap regressions

	Gross operating surplus to output short-term elasticity[1]			Model AR(1), [1]				Model ECT, [2]						Model ECT+AR(1), [3]						N	Dummies
	e(gos,y)	R^2 adj.	Model[2]	dln(y)	R^2 adj.	DW	SE	dln(y)	ln(gos $_{t-1}$)	ln(y $_{t-1}$)	R^2 adj.	DW	SE	dln(y)	ln(gos $_{t-1}$)	ln(y $_{t-1}$)	R^2 adj.	DW	SE		
Australia	1.02 *	0.25	[2]	0.48	0.03	2.01	0.03	1.02 *	-0.05 *	1.04 *	0.25	2.23	0.02	1.06 *	-0.05 *	1.03 **	0.22	2.01	0.02	24	90/10
Austria	1.44 **	0.72	[1]	1.44 **	0.72	1.81	0.01	1.41 **	-0.03	-0.06	0.73	1.66	0.01	1.37 **	-0.03	-0.07	0.72	1.83	0.01	24	
Belgium	1.21 **	0.68	[2]	1.40 **	0.66	1.83	0.02	1.21 **	0.00	-0.51 *	0.68	1.97	0.02	1.19 **	0.00	-0.44	0.67	1.88	0.02	24	04
Canada	2.49 **	0.73	[1]	2.49 **	0.73	1.98	0.02	2.73 **	-0.05	0.35	0.75	2.04	0.02	2.72 **	-0.05	0.35	0.74	2.02	0.02	24	
Chile	2.18 **	0.45	[1]	2.18 **	0.45	1.76	0.06	2.06 **	-0.04	-0.60	0.47	1.48	0.05	1.92 *	-0.07	-0.58	0.47	1.82	0.06	16	06
Czech Republic	1.13 **	0.60	[3]	0.81 *	0.15	1.78	0.04	1.03 **	-0.17 **	0.39	0.47	2.59	0.03	1.13 **	-0.21 **	0.59 **	0.60	1.52	0.03	16	
Denmark	1.91 **	0.79	[1]	1.91 **	0.79	2.15	0.02	2.04 **	0.01	-0.16	0.78	2.71	0.02	1.81 **	0.00	-0.13	0.78	2.12	0.02	24	
Estonia	1.43 **	0.95	[1]	1.43 **	0.95	1.78	0.02	1.36 **	-0.05	-0.01	0.96	1.71	0.02	1.35 **	-0.08	-0.05	0.95	1.78	0.02	11	
Finland	1.58 **	0.85	[2]	1.84 **	0.79	1.76	0.03	1.58 **	-0.06	-0.32 *	0.85	1.84	0.02	1.59 **	-0.06	-0.32	0.84	1.89	0.02	24	
France	1.64 **	0.76	[1]	1.64 **	0.76	1.99	0.01	1.68 **	0.00	0.19	0.76	1.71	0.01	1.70 **	0.00	0.18	0.75	1.90	0.01	24	
Germany	1.16 **	0.73	[2]	1.23 **	0.66	2.09	0.02	1.16 **	-0.06 *	-0.03	0.73	2.03	0.02	1.17 **	-0.06 *	-0.02	0.71	2.01	0.02	24	
Greece	1.30 **	0.69	[1]	1.30 **	0.69	1.98	0.03	1.12 **	-0.11	0.18	0.61	2.82	0.03	1.05 **	-0.07	0.14	0.68	2.19	0.03	17	
Hungary	1.03 **	0.72	[1]	1.03 **	0.72	2.40	0.03	0.55	-0.13 **	-0.14	0.84	1.75	0.03	0.66 *	-0.13 **	-0.16	0.79	1.71	0.03	17	97/05
Iceland	..	..	NA	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Ireland	2.01 **	0.68	[1]	2.01 **	0.68	1.55	0.04	2.00 **	-0.03	0.15	0.69	1.46	0.04	1.98 **	-0.03	0.15	0.67	1.52	0.04	24	
Israel	..	..	NA	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Italy	1.34 **	0.93	[3]	1.39 **	0.87	1.97	0.01	1.33 **	-0.08 **	-0.03	0.93	1.98	0.01	1.34 **	-0.08 **	-0.05	0.93	1.95	0.01	24	95/98
Japan	1.63 **	0.84	[1]	1.63 **	0.84	2.21	0.01	1.69 **	0.11	-0.11	0.84	2.27	0.01	1.71 **	0.12	-0.11	0.83	2.19	0.02	24	
Korea	1.16 **	0.66	[2]	1.12 **	0.41	1.73	0.04	1.16 **	-0.07 **	0.27	0.66	2.08	0.03	1.14 **	-0.07 **	0.27	0.65	1.95	0.03	24	
Latvia	1.08 **	0.60	[1]	1.08 **	0.60	1.97	0.05	1.02 **	-0.07	0.04	0.46	1.02	0.06	1.08 **	-0.04	0.04	0.52	1.94	0.06	14	
Luxembourg	..	..	NA	2.25 **	0.84	1.26	0.04	1.47 *	-0.27	-0.40	0.74	2.05	0.04	2.48	-0.41	1.32	0.76	1.69	0.04	6	
Mexico	..	..	NA	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Netherlands	1.18 **	0.61	[3]	1.37 **	0.54	1.91	0.02	1.20 **	-0.02	-0.37	0.60	2.37	0.02	1.18 **	-0.02	-0.42 *	0.61	1.82	0.02	24	01
New Zealand	1.28 **	0.49	[1]	1.28 **	0.49	1.62	0.02	1.19 **	-0.02	-0.09	0.45	1.76	0.02	1.18 **	0.00	-0.18	0.45	1.58	0.02	22	12
Norway	1.73 **	0.39	[1]	1.73 **	0.39	1.94	0.03	1.57 **	0.01	-0.35	0.37	2.16	0.03	1.57 **	0.01	-0.33	0.35	1.91	0.03	24	04/95/10
Poland	1.73 **	0.69	[3]	2.12 **	0.37	2.28	0.03	2.04 **	-0.09 **	-0.42	0.73	2.63	0.03	1.73 **	-0.08 **	-0.37	0.69	2.12	0.02	16	
Portugal	1.01 **	0.75	[2]	1.04 **	0.64	2.07	0.02	1.01 **	-0.08 **	-0.08	0.75	1.79	0.75	1.00 **	-0.08 **	-0.08	0.74	1.91	0.02	24	94/96/99
Slovak Republic	1.31 **	0.73	[3]	1.56 **	0.53	1.79	0.04	1.07 **	-0.11 **	-0.58 *	0.68	2.00	0.03	1.31 **	-0.16 **	-0.31	0.73	2.18	0.03	16	
Slovenia	1.20 **	0.81	[2]	1.33 **	0.76	2.10	0.03	1.20 **	-0.15 **	0.03	0.81	1.77	0.02	1.19 **	-0.16 *	0.05	0.77	1.80	0.03	12	
Spain	1.43 **	0.58	[2]	1.58 **	0.48	1.86	0.02	1.43 **	-0.04 *	-0.19	0.58	1.91	0.02	1.42 **	-0.04 *	-0.19	0.56	1.86	0.02	24	
Sweden	1.23 **	0.77	[3]	1.29 **	0.67	2.12	0.02	1.16 **	-0.15 **	0.17	0.78	1.69	0.02	1.23 **	-0.16 **	0.20	0.77	1.92	0.02	24	92/96
Switzerland	2.69 **	0.77	[3]	2.66 **	0.69	1.94	0.03	2.58 **	-0.15 *	0.18	0.74	1.49	0.02	2.69 **	-0.77 **	1.48 *	0.77	1.96	0.02	24	
Turkey	..	..	NA	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
United Kingdom	1.15 **	0.31	[1]	1.15 **	0.31	2.15	0.02	1.08 **	-0.03	0.05	0.24	1.54	0.03	1.15 **	-0.03	0.01	0.25	2.10	0.03	24	98/01
United States	0.81 **	0.32	[1]	0.81 **	0.32	2.06	0.02	0.78 **	0.00	0.05	0.19	1.32	0.02	0.80 **	0.00	-0.01	0.25	2.05	0.02	24	98/00
OECD[3]	**1.45**	**0.66**		**1.50**	**0.60**	**1.93**	**0.03**	**1.42**	**-0.06**	**-0.04**	**0.65**	**1.93**	**0.05**	**1.45**	**-0.09**	**0.06**	**0.65**	**1.91**	**0.03**		

Key: * Statistically significant at 10% level; ** Statistically significant at 5% level. OECD averages are unweighted averages.

1. Constant, AR(1) and dummies not shown.

2. See Annex for methodology of model selection; (NA) is applied where there are missing data or too few observation; (NS) when estimates are not statistically significant.

3. Average calculated over statistically significant coefficient estimates.

Source: OECD calculations, OECD Economic Outlook 96 database.

Table A1.9. Capital income to output gap regressions

	Capital income to output short-term elasticity[1]			Model AR(1), [1]				Model ECT, [2]						Model ECT+AR(1), [3]						N	Dummies
	e(ype,y)	R^2 adj.	Model[2]	dln(y)	R^2 adj.	DW	SE	dln(y)	ln(ype $_{t-1}$)	ln(y $_{t-1}$)	R^2 adj.	DW	SE	dln(y)	ln(ype $_{t-1}$)	ln(y $_{t-1}$)	R^2 adj.	DW	SE		
Australia	4.57 **	0.52	[2]	1.89	0.13	1.72	0.09	4.57 **	-0.01	4.76 **	0.52	2.09	0.07	4.66 **	0.00	4.73 **	0.49	2.06	0.07	24	95
Austria	3.81 **	0.43	[3]	3.41 *	0.25	1.82	0.09	4.45 **	-0.36 *	3.64 *	0.41	1.49	0.08	3.81 **	-0.59	4.72 *	0.43	1.75	0.08	24	
Belgium	3.97 **	0.39	[2]	2.58 *	0.06	1.72	0.08	3.97 **	-0.18	3.11 *	0.39	1.95	0.06	4.30 **	-0.11	3.11 *	0.37	1.78	0.06	24	93
Canada	2.25 **	0.71	[3]	1.26 *	0.47	1.45	0.04	2.54 **	0.09	2.35 **	0.60	1.23	0.04	2.25 **	-0.12	2.35 **	0.71	1.80	0.03	24	95/02
Chile	2.92 **	0.78	[3]	2.06 **	0.40	1.32	0.06	2.49 **	-0.02	1.09	0.39	2.43	0.06	2.92 **	-0.08	1.70 **	0.78	2.34	0.04	12	
Czech Republic	2.03 **	0.54	[3]	1.93 **	0.36	2.48	0.06	1.31	-0.52 *	2.00 *	0.33	0.66	0.09	2.03 **	-0.67 *	2.14 *	0.54	2.79	0.05	16	
Denmark	1.84 *	0.46	[3]	1.64	0.14	2.07	0.08	1.90 *	-0.20	1.87 **	0.48	1.76	0.06	1.84 *	-0.26	1.97 **	0.46	2.09	0.07	24	99/02
Estonia	3.54 *	0.36	[3]	3.14 *	0.25	1.90	0.30	3.68 *	-0.12	2.03 *	0.44	2.45	0.25	3.54 *	-0.09	2.00 *	0.36	2.05	0.28	11	
Finland	3.70 **	0.66	[3]	2.72 *	0.23	2.06	0.12	3.23 **	-0.27	2.64 **	0.61	2.51	0.09	3.70 **	-0.23 *	2.84 **	0.66	2.01	0.08	24	92
France	3.52 **	0.61	[2]	2.97 **	0.34	2.00	0.05	3.52 **	-0.17	2.23 **	0.61	2.01	0.04	3.55 **	-0.16	2.22 **	0.59	1.98	0.04	24	99
Germany	1.82 **	0.54	[3]	1.42 **	0.21	1.87	0.05	1.57 **	-0.12 *	1.05 *	0.43	2.79	0.04	1.82 **	-0.11 **	1.02 *	0.54	1.86	0.04	24	
Greece	..	..	NS	1.47	0.65	1.48	0.10	1.29	-0.08	-1.04	0.69	1.52	0.10	1.67	-0.24	-0.44	0.71	1.74	0.09	24	99/02
Hungary	..	..	NS	0.05	-0.07	2.01	0.11	-0.46	-0.30 **	1.95 *	0.36	2.41	0.09	-0.38	-0.29 **	1.73 *	0.34	2.12	0.09	17	
Iceland	..	..	NA	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Ireland	1.51 *	0.80	[1]	1.51 *	0.80	1.68	0.09	1.32	0.04	0.04	0.78	1.97	0.10	1.62 *	0.08	-0.14	0.78	1.79	0.10	24	09/94
Israel	..	..	NA	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Italy	3.51 **	0.60	[1]	3.51 **	0.60	2.07	0.05	2.97 **	-0.37 **	1.08 *	0.63	1.08	0.04	3.37 **	-0.48	2.50 *	0.73	1.74	0.04	24	09/94
Japan	2.26 **	0.69	[3]	1.35 **	0.60	1.40	0.06	3.52 **	-0.14 **	3.19 **	0.61	1.44	0.06	2.26 **	-0.19	2.26 *	0.69	1.72	0.05	24	
Korea	..	..	NS	-0.98 *	0.32	1.89	0.08	-0.55	-0.20 **	0.93	0.53	1.41	0.06	-0.65	-0.32	0.60	0.56	1.89	0.06	24	
Latvia	..	..	NA	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Luxembourg	..	..	NA	5.33	-0.03	1.89	0.31	5.36 *	-0.75 *	7.29 **	0.87	3.21	0.12	..	..	..	..	..	..	5	
Mexico	..	..	NA	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Netherlands	2.58 **	0.77	[3]	2.57 **	0.66	1.89	0.04	2.89 **	-0.29 **	0.88 *	0.76	2.39	0.03	2.58 **	-0.20 **	0.79 *	0.77	2.35	0.03	24	10/02
New Zealand	2.02 **	0.29	[3]	1.67 *	0.11	1.96	0.06	1.98 *	-0.19 *	1.63 *	0.25	2.53	0.05	2.02 **	-0.15	1.54 *	0.29	2.04	0.05	22	
Norway	..	..	NS	-2.20	0.17	2.48	0.25	-2.46	-0.71 **	0.22	0.25	2.17	0.23	-2.47	-0.38 *	0.78	0.27	2.23	0.23	24	
Poland	..	..	NS	1.73	-0.12	2.12	0.13	1.79	-0.43 *	4.46 *	0.45	1.94	0.10	3.97	-0.05	5.94 **	0.39	2.36	0.09	15	
Portugal	..	..	NS	2.45	0.08	1.72	0.11	1.07	-0.25	-0.05	0.12	1.37	0.11	1.47	-0.42	0.09	0.16	1.77	0.11	24	
Slovak Republic	4.66 **	0.54	[3]	1.93	0.03	1.81	0.18	2.79	-0.20	3.19 *	0.23	2.76	0.16	4.66 **	0.07	3.59 **	0.54	2.23	0.12	16	
Slovenia	..	..	NA	3.37 *	0.36	1.85	0.13	2.42	-0.51	2.53 *	0.51	1.28	0.12	3.52 *	-0.76 *	4.87 *	0.56	1.47	0.11	12	
Spain	3.41 *	0.71	[1]	3.41 *	0.71	1.92	0.11	3.37 *	-0.07	1.35	0.73	1.82	0.11	3.38 *	-0.07	1.35	0.71	1.88	0.11	24	96/10
Sweden	3.39 **	0.59	[3]	3.15 **	0.48	1.84	0.11	4.61 **	0.04	2.49 *	0.47	1.32	0.11	3.39 **	-0.46 *	3.45 *	0.59	1.71	0.10	24	00/08
Switzerland	3.91 **	0.63	[1]	3.91 **	0.63	1.77	0.05	4.21 **	-0.12	0.59	0.61	1.42	0.05	3.81 **	-0.26	0.95	0.64	1.65	0.05	24	91
Turkey	..	..	NA	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
United Kingdom	3.39 **	0.57	[2]	3.40 *	0.21	2.21	0.08	3.39 **	-0.55 **	3.02 **	0.57	1.93	0.06	3.42 **	-0.56 *	3.07 *	0.55	1.95	0.06	24	
United States	1.84 **	0.30	[1]	1.84 **	0.30	1.84	0.04	2.05 **	0.02	0.28	0.26	1.58	0.04	2.02 **	-0.01	0.43	0.26	1.84	0.04	24	
OECD[3]	**3.02**	**0.57**		**1.90**	**0.27**	**1.65**	**0.09**	**2.20**	**-0.20**	**1.79**	**0.44**	**1.67**	**0.08**	**2.18**	**-0.21**	**1.83**	**0.46**	**1.68**	**0.07**		

Key: * Statistically significant at 10% level; ** Statistically significant at 5% level. OECD averages are unweighted averages.

1. Constant, AR (1) and dummies not shown, The data source for capital incomes, based on OECD ADB database are subject to frequent national revisions.
2. See Annex for methodology of model selection; (NA) is applied where there are missing data or too few observations; (NS) when estimates are not statistically significant.
3. Average calculated over statistically significant coefficient estimates.

Source: OECD calculations, OECD Economic Outlook 96 database.

Table A1.10. Adjusted elasticities for wages and salaries, self-employment incomes and gross operating surplus with respect to the output gap

	Adjusted elasticities[1]				Elasticity of tax base to output gap[2]			GDP weights		
	Self-employment income	Wages and salaries	Gross operating surplus	Weighted sum	Self-employment income	Wages and salaries	Gross operating surplus	Self-employment income	Wages and salaries	Gross operating surplus
Australia	1.29	1.03	0.90	1.00	1.46 NS/NA	1.03 **	1.02 *	0.10	0.49	0.42
Austria	0.96	0.77	1.32	1.00	1.05 **	0.77 **	1.44 **	0.11	0.51	0.38
Belgium	1.13	0.63	1.48	1.00	1.13 **	0.63 **	1.21 **	0.10	0.52	0.38
Canada	0.70	0.89	1.20	1.00	1.46 NS/NA	0.89 **	2.49 **	0.09	0.51	0.40
Chile	0.81	0.68	1.24	1.00	1.42 **	0.68 **	2.18 **	0.08	0.37	0.55
Czech Republic	1.35	0.84	1.04	1.00	1.46 NS/NA	0.84 **	1.13 **	0.14	0.42	0.44
Denmark	1.22	0.54	1.59	1.00	1.46 NS/NA	0.54 **	1.91 **	0.05	0.54	0.40
Estonia	0.92	1.03	0.98	1.00	1.33 **	1.49 **	1.43 **	0.07	0.47	0.46
Finland	1.22	0.70	1.32	1.00	1.46 NS/NA	0.70 **	1.58 **	0.07	0.50	0.42
France	1.33	0.73	1.29	1.00	1.69 **	0.73 **	1.64 **	0.12	0.53	0.35
Germany	1.97	0.61	1.31	1.00	1.76 **	0.54 **	1.16 **	0.09	0.53	0.38
Greece	1.14	0.66	1.17	1.00	1.26 **	0.73 **	1.30 **	0.27	0.31	0.42
Hungary	0.96	0.87	1.15	1.00	0.86 *	0.87 **	1.03 **	0.12	0.46	0.42
Iceland	1.12	0.88	1.11	1.00	1.46 NS/NA	0.88 **	1.45 NS/NA	0.12	0.48	0.40
Ireland	0.91	0.74	1.25	1.00	1.46 NS/NA	0.74 **	2.01 **	0.10	0.42	0.48
Israel	1.24	0.75	1.23	1.00	1.46 NS/NA	0.88 **	1.45 NS/NA	0.12	0.48	0.40
Italy	0.81	0.57	1.51	1.00	0.71 **	0.57 **	1.34 **	0.17	0.42	0.41
Japan	1.09	0.82	1.22	1.00	1.46 NS/NA	0.82 **	1.63 **	0.08	0.52	0.40
Korea	1.16	1.03	0.91	1.00	1.46 NS/NA	1.31 **	1.16 **	0.13	0.45	0.42
Latvia	1.28	0.73	0.94	1.00	1.46 NS/NA	0.84 NS/N	1.08 **	0.45	0.43	0.12
Luxembourg	1.25	0.58	1.24	1.00	1.46 NS/NA	0.68 **	1.45 NS/NA	0.08	0.36	0.56
Mexico	1.24	0.75	1.23	1.00	1.46 NS/NA	0.88 **	1.45 NS/NA	0.12	0.48	0.40
Netherlands	1.93	0.71	1.18	1.00	4.54 **	0.71 **	1.18 **	0.07	0.51	0.42
New Zealand	1.45	0.64	1.27	1.00	1.46 NS/NA	0.64 *	1.28 **	0.04	0.44	0.53
Norway	1.06	0.84	1.25	1.00	1.46 NS/NA	1.16 **	1.73 **	0.08	0.57	0.35
Poland	0.80	0.95	1.16	1.00	1.19 **	1.42 **	1.73 **	0.25	0.34	0.40
Portugal	1.34	0.98	0.92	1.00	1.46 NS/NA	1.07 **	1.01 **	0.11	0.51	0.38
Slovak Republic	0.94	0.67	1.35	1.00	0.91 **	0.67 **	1.31 **	0.20	0.39	0.41
Slovenia	1.60	0.65	1.31	1.00	1.46 NS/NA	0.65 **	1.20 **	0.12	0.52	0.37
Spain	1.01	0.86	1.19	1.00	1.20 *	0.86 **	1.43 **	0.16	0.49	0.35
Sweden	1.06	0.77	1.30	1.00	1.01 *	0.77 **	1.23 **	0.05	0.54	0.41
Switzerland	0.86	0.69	1.58	1.00	1.46 NS/NA	0.69 **	2.69 **	0.08	0.59	0.34
Turkey	1.26	0.72	1.25	1.00	1.46 NS/NA	0.84 NS/N	1.45 NS/NA	0.12	0.48	0.40
United Kingdom	2.97	0.61	1.15	1.00	1.67 *	0.61 **	1.15 **	0.08	0.54	0.38
United States	1.69	1.18	0.56	1.00	1.69 **	1.18 **	0.81 **	0.08	0.56	0.36
OECD	**1.23**	**0.77**	**1.20**	**1.00**	**1.46**	**0.84**	**1.45**	**0.12**	**0.48**	**0.40**

1. Elasticity estimates for countries with NA or NS specification are set to the OECD average. NA is applied where there are missing data and too few observations for the regression. NS denotes not statistically significant estimates. OECD averages are unweighted averages.
2. OECD averages are calculated over statistically significant estimates and are unweighted. Adjusted elasticities are based on freely estimated elasticities weighted by GDP components. Detailed methodology is described in the annex.

Source: OECD calculations, OECD Economic Outlook 96 database.

Table A1.11. Unemployment to output elasticity regressions

	Unemployment to output gap short-term elasticity[1]			Model AR(1), [1]				Model ECT, [2]						Model ECT+AR(1), [3]						N	Dummies
	e(u,y)	R^2 adj.	Model[2]	dln(y)	R^2 adj.	DW	SE	dln(y)	$\ln(u_{t-1})$	$\ln(y_{t-1})$	R^2 adj.	DW	SE	dln(y)	$\ln(u_{t-1})$	$\ln(y_{t-1})$	R^2 adj.	DW	SE		
Australia	-4.39 **	0.73	[2]	-5.80 **	0.51	2.03	0.06	-4.39 **	-0.62 **	-4.66 **	0.73	1.96	0.05	-4.25 **	-0.73 *	-5.29 **	0.71	2.04	0.05	24	
Austria	-4.01 **	0.49	[2]	-4.15 **	0.37	1.83	0.08	-4.01 **	-0.36 *	-1.62	0.49	1.78	0.07	-4.13 **	-0.70	-2.62	0.48	2.01	0.07	24	
Belgium	-4.09 **	0.78	[3]	-2.60 *	0.32	1.88	0.07	-4.26 **	-0.50 **	-5.83 **	0.70	1.10	0.05	-4.09 **	-0.69 **	-7.02 **	0.78	1.61	0.04	24	
Canada	-4.77 **	0.87	[3]	-4.82 **	0.83	1.92	0.04	-4.79 **	-0.27	-1.60 *	0.85	1.40	0.03	-4.77 **	-0.72 *	-4.29 **	0.87	1.81	0.03	24	
Chile	-4.41 **	0.62	[3]	-4.48 **	0.53	1.95	0.10	-4.29 **	-0.42 *	-1.98 *	0.60	1.56	0.09	-4.41 **	-0.80	-4.44 *	0.62	1.74	0.09	24	
Czech Republic	-3.74 *	0.65	[3]	-4.88 **	0.47	1.46	0.12	-3.36 *	-0.72 *	-3.80 **	0.64	1.34	0.10	-3.74 *	-0.79	-4.45	0.65	1.50	0.10	16	
Denmark	-4.91 **	0.74	[3]	-5.80 **	0.52	1.79	0.10	-4.59 **	-0.71 **	-5.41 **	0.73	1.46	0.08	-4.91 **	-0.82 *	-6.38 *	0.74	1.84	0.07	24	
Estonia	-3.93 **	0.98	[3]	-4.43 **	0.85	1.33	0.13	-3.91 **	-0.92 **	-5.14 **	0.97	1.39	0.06	-3.93 **	-0.92 **	-5.24 **	0.98	2.36	0.05	11	
Finland	-3.19 **	0.85	[3]	-3.35 **	0.65	1.83	0.08	-3.41 **	-0.61 **	-3.49 **	0.84	1.35	0.05	-3.19 **	-0.78 **	-4.17 **	0.85	1.90	0.05	24	
France	-2.33 *	0.65	[2]	-3.28 **	0.36	1.96	0.05	-2.33 *	-0.66 **	-3.12 **	0.65	1.75	0.04	-2.49 *	-0.76 *	-3.55 *	0.64	1.91	0.04	24	
Germany	-3.07 **	0.59	[1]	-3.07 **	0.59	1.84	0.05	-4.71 **	0.01	-1.01	0.57	1.72	0.06	-3.65 **	-0.10	-1.27	0.59	1.84	0.05	18	05/10
Greece	-2.51 **	0.76	[2]	-3.19 **	0.54	1.91	0.07	-2.51 **	-0.73 **	-3.00 **	0.76	1.60	0.05	-2.37 **	-0.81 *	-3.25 *	0.75	1.74	0.05	24	
Hungary	-2.12 **	0.70	[3]	-1.96 **	0.61	1.95	0.04	-1.73 **	-0.24 *	-0.26	0.66	2.50	0.03	-2.12 **	-0.20 *	-0.33	0.70	2.01	0.03	18	05/10
Iceland	-7.16 **	0.62	[2]	-6.68 **	0.53	2.02	0.18	-7.16 **	-0.38 *	-1.77	0.62	2.18	0.16	-7.17 **	-0.30	-1.14	0.61	2.07	0.16	24	
Ireland	-4.67 **	0.73	[2]	-4.67 **	0.64	1.86	0.11	-4.67 **	-0.55 **	-3.08 **	0.73	1.49	0.09	-4.47 **	-0.71	-3.93	0.73	1.72	0.09	24	
Israel	-2.13 **	0.89	[2]	-2.03 *	0.29	2.30	0.07	-2.13 **	-1.08 **	-2.47 **	0.89	2.15	0.03	-2.08 **	-1.22 **	-2.97 **	0.94	2.41	0.02	24	94/05/08
Italy	-2.91 **	0.68	[2]	-1.97 *	0.36	1.96	0.06	-2.91 **	-0.18 *	-2.70 **	0.68	1.98	0.05	-3.06 **	-0.14	-2.67 **	0.66	1.76	0.05	24	
Japan	-3.14 **	0.85	[3]	-2.90 **	0.60	1.92	0.05	-3.44 **	-0.70 **	-3.86 **	0.80	0.92	0.04	-3.14 **	-0.93 **	-4.75 **	0.85	1.31	0.03	24	
Korea	-5.70 **	0.74	[1]	-5.70 **	0.74	1.85	0.10	-6.61 **	-0.44 *	-4.80 **	0.84	1.22	0.08	-6.60 **	-0.79 **	-7.78 **	0.88	1.63	0.07	24	
Latvia	-4.15 **	0.89	[1]	-4.15 **	0.89	1.71	0.08	-3.94 **	-0.59 *	-2.88 *	0.94	1.83	0.06	-4.05 **	-0.45	-2.37	0.93	1.64	0.06	15	
Luxembourg	-2.00 **	0.77	[3]	-2.48 **	0.66	1.91	0.05	-1.81 **	-0.53 **	-1.52 *	0.79	1.95	0.04	-2.00 **	-0.54 *	-2.00 *	0.77	2.05	0.04	18	01/08
Mexico	-2.69 *	0.61	[2]	-2.62 *	0.14	2.13	0.13	-2.69 *	-0.48 **	-3.32 **	0.61	2.39	0.09	-3.14 *	-0.42 **	-3.29 **	0.54	1.86	0.09	17	
Netherlands	-5.70 **	0.88	[3]	-5.72 **	0.52	1.76	0.10	-6.22 **	-0.57 **	-8.09 **	0.86	1.36	0.06	-5.70 **	-0.70 **	-9.04 **	0.88	1.96	0.05	24	
New Zealand	-3.37 **	0.57	[3]	-3.57 **	0.28	2.06	0.08	-3.88 **	-0.72 **	-3.99 **	0.56	1.74	0.06	-3.37 **	-1.00 *	-5.36 **	0.57	1.79	0.06	23	
Norway	-4.47 **	0.70	[2]	-5.61 **	0.46	1.77	0.08	-4.47 **	-0.64 **	-5.24 **	0.70	1.59	0.06	-4.38 **	-0.70 *	-5.50 **	0.69	1.62	0.06	24	
Poland	-2.48 *	0.70	[2]	-1.76	0.44	1.89	0.08	-2.48 *	-0.47 **	-1.21	0.70	1.96	0.06	-1.83	-0.48 **	-1.28	0.69	2.00	0.06	24	07/08
Portugal	-4.67 **	0.64	[2]	-4.62 **	0.53	1.90	0.09	-4.67 **	-0.33 *	-2.98 **	0.64	1.27	0.08	-4.36 **	-0.64 *	-4.83 *	0.69	1.93	0.07	24	
Slovak Republic	-2.09 **	0.86	[3]	-2.09 **	0.66	2.25	0.05	-2.28 **	-0.76 **	-2.80 **	0.86	1.85	0.03	-2.09 **	-1.02 **	-3.37 **	0.86	1.90	0.03	17	03/99/10
Slovenia	-2.73 **	0.85	[3]	-2.64 **	0.61	1.88	0.07	-2.86 **	-0.38	-1.80 *	0.64	1.25	0.06	-2.73 **	-0.90 **	-3.82 **	0.85	2.50	0.04	12	
Spain	-6.77 **	0.88	[1]	-6.77 **	0.88	1.77	0.05	-6.82 **	-0.06	0.10	0.89	1.74	0.04	-6.82 **	-0.08	-0.06	0.88	1.84	0.05	24	94/05/08
Sweden	-4.52 **	0.86	[3]	-3.57 **	0.72	1.72	0.09	-4.34 **	-0.20 *	-3.06 **	0.80	1.25	0.08	-4.52 **	-0.37 *	-4.50 **	0.86	1.76	0.07	24	91/92/01
Switzerland[3]	..	..	NS	-8.60 **	0.54	1.45	0.19	-12.46 **	-0.34 *	-6.30 *	0.54	1.05	0.19	-10.13 **	-0.61	-11.32 *	0.71	1.03	0.15	24	
Turkey	-2.28 **	0.51	[1]	-2.28 **	0.51	1.88	0.10	-2.51 **	-0.11	-1.01 *	0.59	1.57	0.09	-2.50 **	-0.58	-2.14	0.59	1.77	0.09	14	
United Kingdom	-4.28 **	0.67	[3]	-4.05 **	0.54	1.93	0.06	-4.46 **	-0.28 *	-2.24 *	0.58	1.30	0.06	-4.28 **	-0.64 *	-4.40 **	0.67	2.00	0.05	24	
United States	-7.65 **	0.76	[1]	-7.65 **	0.76	1.94	0.07	-8.13 **	-0.18	-1.32	0.77	1.66	0.07	-7.16 **	-0.88 **	-9.06 **	0.85	1.13	0.06	24	
OECD[4]	**-3.91**	**0.74**	**0.00**	**-4.11**	**0.56**	**1.87**	**0.08**	**-4.26**	**-0.48**	**-3.06**	**0.72**	**1.62**	**0.07**	**-4.10**	**-0.66**	**-4.22**	**0.75**	**1.83**	**0.06**		

Key: * Statistically significant at 10% level; ** Statistically significant at 5% level. OECD averages are unweighted averages.

1. Constant, AR(1) and dummies not shown.
2. See Annex for methodology of model selection; (NA) is applied where there are missing data or too few observations; (NS) when estimates are not statistically significant.
3. Switzerland is set to NS. Error correction terms coefficients are not statistically significant for specification 2 and 3. But the value of DW for specification 1 is too low suggesting risks of residuals autocorrelation.
4. Average calculated over coefficient estimates statistically significant.

Source: OECD calculations, OECD Economic Outlook 96 database.

Table A1.12. Revisions of personal income and social security tax to tax base elasticities

New and 2005 Methodology

	Income tax / output gap elastictity					Social security/output gap elasticity		
				due to :				
	Total personal income	2005 estimate	Revision	Tax revenue / tax base	Tax base / output gap	Social security contributions	2005 estimate	Revision
Australia	2.25	1.04	1.21	0.10	1.11	0.00	0.00	0.00
Austria	1.81	1.31	0.50	-0.23	0.73	0.71	0.58	0.13
Belgium	1.34	1.09	0.25	0.02	0.24	0.72	0.80	-0.08
Canada	2.19	1.10	1.09	0.44	0.66	0.63	0.56	0.07
Chile	1.90	..	..	..	..	0.68	..	..
Czech Republic	2.13	1.19	0.94	0.53	0.41	0.83	0.80	0.03
Denmark	0.98	0.96	0.03	0.03	-0.01	0.38	0.72	-0.34
Estonia	1.56	..	..	..	..	1.39	..	..
Finland	1.36	0.91	0.45	-0.02	0.46	0.70	0.62	0.08
France	1.85	1.18	0.66	-0.02	0.69	0.70	0.79	-0.10
Germany	1.86	1.61	0.25	-0.42	0.67	0.52	0.57	-0.04
Greece	2.00	1.80	0.20	0.21	0.00	0.55	0.85	-0.30
Hungary	1.80	1.70	0.09	-0.63	0.72	0.86	0.63	0.23
Iceland	1.81	0.86	0.94	0.28	0.67	0.92	0.60	0.32
Ireland	1.57	1.44	0.12	-0.06	0.18	1.06	0.88	0.18
Israel	1.85	..	..	..	..	0.92	..	..
Italy	1.43	1.79	-0.36	-0.15	-0.21	0.55	0.86	-0.31
Japan	1.76	1.17	0.59	-0.13	0.73	0.72	0.55	0.18
Korea	2.64	1.40	1.24	-0.10	1.34	0.89	0.51	0.38
Latvia	1.32	..	..	..	..	0.73	..	..
Luxembourg	1.56	1.50	0.06	-0.26	0.33	0.53	0.76	-0.23
Mexico	1.91	..	..	..	..	0.80	..	..
Netherlands	1.94	1.69	0.25	-0.40	0.65	0.57	0.56	0.01
New Zealand	1.23	0.92	0.31	0.05	0.26	0.00	0.00	0.00
Norway	1.63	1.02	0.61	0.03	0.58	0.85	0.80	0.05
Poland	1.87	1.00	0.87	0.53	0.34	0.92	0.69	0.23
Portugal	2.29	1.53	0.76	0.45	0.31	0.98	0.92	0.06
Slovak Republic	1.77	0.70	1.07	1.43	-0.36	0.66	0.70	-0.04
Slovenia	1.62	..	..	..	..	0.65	..	..
Spain	1.76	1.92	-0.16	-0.22	0.06	0.71	0.68	0.03
Sweden	1.43	0.92	0.50	0.12	0.39	0.73	0.72	0.01
Switzerland	1.93	1.10	0.83	0.03	0.80	0.57	0.69	-0.12
Turkey	1.78	..	..	..	..	0.70	..	..
United Kingdom	1.71	1.18	0.53	-0.21	0.74	0.73	0.91	-0.18
United States	2.08	1.30	0.78	-0.26	1.04	1.00	0.64	0.37
OECD	**1.77**	**1.26**	**0.52**	**0.04**	**0.48**	**0.71**	**0.66**	**0.02**

Note: OECD averages are unweighted averages.

Source: OECD calculations.