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New Tax and Expenditure Elasticity Estimates for EU Budget Surveillance

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Thai-Thanh Dang,
Yvan Guillemette

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By Robert W.R. Price, Thai-Thanh Dang and Yvan Guillemette

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ABSTRACT/RÉSUMÉ

New tax and expenditure elasticity estimates for EU budget surveillance

This paper estimates the elasticities of government revenue and expenditure items with respect to the output gap for European Union (EU) countries. These elasticities are used by the European Commission, as part of the EU fiscal surveillance process, to calculate the semi-elasticity of the budget balance as a percentage of GDP with respect to the output gap. The study updates the earlier 2005 study of OECD economies using the most recent datasets and tax codes, the coverage being confined in this paper to the 28 EU member states, seven of which are not OECD members. The same basic 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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Nouvelles estimations de l'élasticité des taxes et dépenses pour la surveillance budgétaire de l'UE

Cette étude estime les élasticités des composantes des revenus et des dépenses gouvernementales par rapport à l'écart de production pour les pays de l'Union Européenne (UE). Ces élasticités sont utilisées par la Commission Européenne, dans son processus de surveillance fiscale, pour calculer la semi-élasticité du solde budgétaire en pourcentage du PIB par rapport à l'écart de production. L'étude met à jour la précédente étude de 2005 couvrant les économies de l'OCDE en utilisant les données et les codes des impôts les plus récents, la couverture de l'étude étant confinée aux 28 pays membres de l'UE, dont sept ne sont pas membres de l'OCDE. La même méthodologie en deux temps est retenue : les élasticités des revenus et dépenses par rapport à l'écart de production étant définies comme le produit de, en premier, l'élasticité des composantes individuelles de dépense et de revenu par rapport à leurs bases et, en deuxième, l'élasticité de ces bases par rapport à l'écart de production. Un ensemble d'améliorations méthodologique sont apportés par rapport à l'étude de 2005. Les révisions des élasticités individuelles par rapport à celles de 2005 sont significatives dans nombre de cas, mais ne suivent pas de tendance particulière, exception faite des élasticités de l'impôt sur les bénéfices qui sont 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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NEW TAX AND EXPENDITURE ELASTICITY ESTIMATES FOR EU BUDGET SURVEILLANCE

By Robert W.R. Price, Thai-Thanh Dang and Yvan Guillemette[1]

I. Introduction

1. This paper presents new elasticity estimates for the cyclical adjustment of EU member budget balances for use in the context of the EU fiscal surveillance and forecasting processes. The existing elasticities are based on the 2003 tax codes and date back to 2005 (referred to as the 2005 model throughout this paper) (Girouard and André 2005).[2] This study, commissioned by the European Commission, applies the same basic 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. It is specifically focuses on the 28 EU members, the aims being to update the elasticity estimates by incorporating information from the latest available tax and benefit codes and to extend the coverage to the new member states, of which the most recent entrants are Bulgaria, Estonia, Cyprus[3, 4], Latvia, Lithuania, Malta, Romania, Slovenia and Croatia. The new elasticities are based on the latest output gap methodology agreed by the Output Gap Working Group of the EU's Economic Policy Committee. They differ from those used by the OECD in the context of its own forecasting exercise as the OECD elasticities are based on OECD output gap estimates and on specific, though marginally different, methodological choices. The paper does not present estimates of cyclically adjusted budget balances. An analysis of the influence of the new elasticities on the cyclically-adjusted budget balances of EU countries as computed by the European Commission is available in Mourre, Astarita and Princen (2014).

2. 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 correspond more closely to reality. The revisions are the following:

- The calculation of aggregate personal income tax elasticities now makes use of more informative and up-to-date income distribution data, which separately identify the major tax base components of personal income: earned income, self-employment income and capital income.
- The social security contribution elasticities take account of employer contributions as well as employee contributions.

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1. Respectively consultant economist, consultant econometrician and senior economist with the OECD Economics Department. Corresponding author: Yvan.Guillemette@oecd.org. The authors would like to thank Christophe André, Caterina Astarita, Sven Blondal, Gilles Mourre, Savina Princen and members of the Output Gap Working Group of the EU's Economic Policy Committee for comments and suggestions on earlier drafts; Sylvie Foucher-Hantala for statistical help; and Isabelle Fakih and Maartje Michelson for help with document preparation. This study was financed by the European Commission.

2. Two vintages of this tool have been in use based on, respectively, Van den Noord (2000) and Girouard and André (2005).

3. Note by Turkey: The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".

4. Note by all the European Union Member States of the OECD and the European Union: The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

- 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 the corporate tax has been dropped.
- The links between non-tax revenues and the output gap have been investigated.
- The tax base/output gap elasticities have been 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.

II. Conceptual and methodological issues

1. The role of elasticities in cyclical adjustment

4. The EU methodology for calculating the cyclically-adjusted budget balance is to adjust the budget balance-to-GDP ratio by subtracting its cyclical component. This cyclical component of the budget balance is the product of the output gap (GAP_t) and a cyclical adjustment parameter (ε) based on the individual elasticities of cyclically sensitive revenue and expenditure items. In algebraic terms, the cyclically-adjusted budget balance (CAB_t) is expressed as:

$$CAB_t = \frac{(R_t - G_t)}{Y_t} - \varepsilon \cdot GAP_t \qquad (1)$$

where R_t and G_t stand for nominal government revenue and expenditure, respectively, and Y_t for nominal GDP. The output gap is the distance between actual and potential GDP (Y_t^*) in percentage points of potential output, $(Y_t - Y_t^*)/Y_t^*$. For details on the computation of the cyclical adjustment parameter ε, which expresses the change in the budget balance as a percentage of GDP relative to the percentage change in the output gap, see Mourre et al. (2014). For details on the computation of the EU output gap, see Havik et al. (2014).

5. For estimation purposes, the short-term elasticities of cyclically sensitive revenue and expenditure items are unbundled into two components: *i)* the elasticity of the individual revenue or expenditure item with respect to its base ($\mathcal{E}_{ti.tbi}$), and *ii)* the elasticity of the base with respect to output ($\mathcal{E}_{tbi.y}$):

$$\varepsilon_{ti,y} = \varepsilon_{ti,tbi} \cdot \varepsilon_{tbi,y} \qquad (2)$$

The first depends on the relevant tax codes while the second is empirically estimated.

6. 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 social security contributions), the gross operating surplus (for corporate income) and consumption (for indirect taxes). However, sometimes it is possible to break a tax category down into several components and estimate elasticities at this finer level of detail. The resulting elasticities are then aggregated using tax weights to arrive at the overall elasticity of the broad tax category. This is the case of personal income tax for instance (see Table A1.2 in the Annex).

2. Scope for enhancement

Further disaggregation

7. 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 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 have a different cyclical behaviour than 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.

- The cyclical adjustment process equates PIT to 'direct taxes on households', which also includes property and wealth taxes. Wealth taxes are not particularly important, since few EU countries levy such a tax. 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.[5] However, they only amount to 2.3% of total revenues on average (Table 1), so 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. (They have been the origin of cyclical volatility in receipts not picked up in the existing adjustment method in the past.) Similarly, indirect taxes also include taxes on financial transactions, which are likely to exhibit a different degree of cyclicality from consumption.[6] 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 – 11% of overall revenue on average -- and the possibility that these may be cyclically related is examined here.

Elasticity estimation processes

8. In the case of personal income taxes and social security contributions, the tax revenue to tax base elasticities are derived from national tax codes. In the case of corporate income taxes and indirect taxes, the 2005 model assumes unit elasticities. Taxes with an elasticity of 1 -- proportional taxes – do not affect the budget balance ratio, which means that, in effect, the principal drivers of cyclical variation in the budget

5. Price and Dang (2011). The relationship is not close, because of a lack of systematic revaluation in many countries.

6. 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).

balance/GDP are personal income taxes and the social security contribution system. In the current analysis, the assumption that corporate income taxes have a unit elasticity 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. The same was tried for indirect taxes, but the unit elasticity assumption was finally retained given the robustness issues affecting the empirical estimates.

9. The regression modelling framework, which is described below, now also allows for the calculation of short-run and long-run tax/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.[7] 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 contribution elasticities with respect to earnings

10. 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, accounting for an average of around two-thirds. Earnings also constitute the base for social security contributions, which means that, on average, around two-fifths of EU government revenues are based on earnings, making this tax base one of the most important drivers of cyclicality.

11. 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).[8] 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 $\varepsilon_{t.ye}$:

$$\varepsilon_{t.ye} = \frac{MR}{AR} = \frac{\sum \omega_{ye,i} \cdot mr_i}{\sum \omega_{ye,i} \cdot ar_i} \qquad (3)$$

where $\omega_{ye,i}$ is the weight of percentile earnings-level *i* in total earnings expressed in currency units earned, mr_i is the marginal income tax rate (social security contribution rate) at point *i* on the earnings distribution and ar_i is the 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.

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

8. 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*.

12. 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.[9] The new calculations are based on an income scale which now covers up to zero to eight times average earnings and the parameters governing the log-normal distribution have been based on actual income distribution data. 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. 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 type, 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 family type.

Table 1. Categorisation of taxes and their bases

National Accounts classification	SNA classification (SNA)	Base	Revenue Statistics (RS)	OECD weights % in total current revenues
GOVERNMENT REVENUES				
1. Direct taxes on households				**22.9**
Taxes on personal income	D51	Earnings Transfers Self-employment income Income from capital	1110	20.1
		Capital gains	1120	
Property taxes	D59	Property values	4100	2.3
Taxes on net wealth		Asset values	4200	0.5
2. Social security contributions				**25.1**
Employee contributions	D29	Wages and salaries	3000	9.2
Employer contributions				15.9
3. Corporate income taxes				**7.2**
	D51	Gross operating surplus and capital gains	1200	7.2
4. Indirect Taxes				**34.7**
Tax on general consumption	D21	Personal consumption	5000	32.9
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	1.8
5.Capital taxes				**0.4**
Estate, inheritance and gift taxes		Asset values	4300	0.4
6. Non-tax revenues				**11.2**
GOVERNMENT EXPENDITURES				
7. Government transfers				**9.7**
Unemployment-related spending		Unemployment		2.9
Income related and family benefits		Earnings		6.8

Source: OECD Revenue Statistics, OECD Standardised National Accounts, OECD Social Expenditures.

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

13. 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. 9). The elasticities vary between 1¼ and 2½. A prominent feature of the calculations is thus the rather wide dispersion of elasticities, around an EU average of 1¾. These differences are explicable in terms of the varying tax structures in operation, ranging from a fairly flat and uniform structure (Bulgaria, 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).

14. Table 3 compares the new PIT elasticity estimates with those of the 2005 exercise, decomposing the changes into statutory and methodological changes.[10] The effect of statutory changes is reported in OECD (2012a)[11], 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/earnings elasticities slightly for the economies covered. Apart from Germany, Portugal, the Netherlands and some of the newer EU member economies, the revisions are in the range 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.[12] 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. 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.

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

11 . 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.

12. 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 methodologies

	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	Revision
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]
Austria	2.20	2.00	1.00	0.85	0.99	0.92	1.25	1.97	-0.23	1.34	0.09
Belgium	1.60	1.63	1.10	1.30	1.00	1.15	1.34	1.62	0.02	1.36	0.02
Bulgaria	..	1.07	..	0.95	0.91	0.93	0.95	1.11	..	0.99	..
Croatia	..	1.77	..	1.00	1.00	1.00	1.23	1.75	..	1.21	..
Cyprus	..	2.31	..	1.00	1.00	1.00	1.49	2.25	..	1.62	..
Czech Republic	1.70	2.24	1.10	0.98	1.00	0.99	1.11	2.23	0.53	1.24	0.13
Denmark	1.40	1.44	1.00	0.70	0.00	0.70	0.89	1.43	0.03	1.38	0.49
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	0.02
France[1]	1.70	1.73	1.10	0.91	0.96	0.95	1.05	1.68	-0.02	1.20	0.15
Germany	2.30	1.90	0.80	0.76	0.97	0.86	1.12	1.88	-0.42	1.22	0.10
Greece	2.00	2.30	0.90	0.76	0.86	0.84	1.10	2.21	0.21	1.26	0.16
Hungary	2.43	1.84	0.90	1.00	0.99	0.99	1.21	1.80	-0.63	1.23	0.02
Ireland	2.10	2.11	1.30	1.49	1.41	1.51	1.87	2.04	-0.06	1.85	-0.02
Italy[2]	2.00	1.84	1.00	1.00	0.96	0.97	1.23	1.85	-0.15	1.39	0.16
Latvia	..	1.29	..	1.00	1.00	1.00	1.10	1.31	..	1.12	..
Lithuania	..	1.45	..	1.00	1.00	1.00	1.11	1.46	..	1.11	..
Luxembourg	2.50	2.28	1.30	0.90	0.93	0.89	1.19	2.24	-0.26	1.39	0.20
Malta	..	2.16	..	0.60	1.01	0.92	1.17	2.11	..	1.62	..
Netherlands	2.40	2.15	0.80	0.75	0.71	0.86	1.39	2.00	-0.40	1.25	-0.14
Poland	1.40	1.96	1.00	0.96	0.98	0.97	1.08	1.93	0.53	1.24	0.16
Portugal	1.70	2.22	1.00	1.00	1.00	1.00	1.21	2.15	0.45	1.40	0.18
Romania	..	1.35	..	1.00	0.99	0.99	1.05	1.36	..	1.12	..
Slovak Republic	..	2.47	1.00	0.97	0.98	1.19	1.29	2.43	..	1.43	0.14
Slovenia	..	2.15	..	1.00	1.00	1.00	1.21	2.14	..	1.34	0.13
Spain	2.10	1.93	0.80	0.88	0.82	0.82	1.11	1.88	-0.22	1.23	0.11
Sweden	1.30	1.45	1.00	0.69	1.00	0.95	1.16	1.42	0.12	1.26	0.10
United Kingdom	1.70	1.50	1.30	0.97	1.33	1.20	1.35	1.49	-0.21	1.37	0.02
European Union	**1.89**	**1.84**	**1.02**	**0.94**	**0.97**	**1.00**	**1.21**	**1.81**	**-0.04**	**1.31**	**0.11**

Note: This table compares tax/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 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's side. Compared to column 6, the differences reflect the employers' contributions in the SSC elasticities.

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

Source : OECD calculations, Girouard, N. and C.André (2005), Measuring cyclically-adjusted budget balances for OECD countries, *Economics Department Working Papers,* No 434 .

Table 3. **Source of revisions of tax revenue 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]
Austria	-0.23	-0.05	-0.08	-0.07	-0.03	-0.15	0.08
Belgium	0.02	-0.03	0.03	0.03	-0.02	0.20	-0.15
Czech Republic	0.53	-0.35	0.95	-0.06	-0.01	-0.11	0.01
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	0.36	-0.04	-0.05	-0.19	0.03
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	-0.14	0.08
Hungary	-0.63	-0.55	0.02	-0.07	-0.03	0.10	-0.01
Ireland	-0.06	0.16	-0.01	-0.13	-0.07	0.19	0.01
Italy	-0.15	0.05	-0.12	-0.09	0.01	0.00	-0.03
Luxembourg	-0.26	-0.09	0.01	-0.15	-0.04	-0.40	-0.01
Netherlands	-0.40	-0.24	0.19	-0.20	-0.16	-0.05	0.10
Poland	0.53	-0.43	1.75	-0.76	-0.03	-0.04	0.02
Portugal	0.45	0.00	1.03	-0.52	-0.06	0.00	0.00
Slovak Republic	..	..	..	..	..	..	..
Slovenia	..	0.26	..	..	..	..	..
Spain	-0.22	0.06	-0.17	-0.06	-0.05	-0.06	-0.06
Sweden	0.12	0.44	-0.26	-0.02	-0.04	-0.31	0.26
United Kingdom	-0.21	0.03	-0.25	0.02	0.00	-0.33	0.23

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

15. The 2005 model takes the personal income tax base solely as earnings, though, as noted, these are only one component of the base, which includes self-employment and capital income (Table 1). The tax/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.

16. 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 2. 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 3, 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 EU countries, the PIT/tax base elasticity falls slightly from 1.9 to 1.8 (Table 2, col. 8 and Table 4, col. 1).

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

New methodology

	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]
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
Bulgaria	1.11	1.07	1.02	1.60	0.65	0.10	0.06
Croatia	1.75	1.77	1.72	1.60	0.65	0.10	0.06
Cyprus	2.25	2.31	2.27	1.60	0.65	0.10	0.06
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
Ireland	2.04	2.11	1.61	1.81	0.60	0.09	0.01
Italy	1.85	1.84	1.89	1.75	0.49	0.21	0.04
Latvia	1.31	1.29	1.24	1.60	0.65	0.10	0.06
Lithuania	1.46	1.45	1.40	1.60	0.65	0.10	0.06
Luxembourg	2.24	2.28	1.92	1.86	0.67	0.05	0.03
Malta	2.11	2.16	2.11	1.60	0.65	0.10	0.06
Netherlands	2.00	2.15	1.84	1.20	0.67	0.08	0.11
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
Romania	1.36	1.35	1.30	1.60	0.65	0.10	0.06
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
United Kingdom	1.49	1.50	1.49	1.48	0.67	0.08	0.09
European Union	**1.81**	**1.84**	**1.70**	**1.60**	**0.64**	**0.09**	**0.05**

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.

Social security contributions

17. 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, based on the actual operational parameters of the contributions system. This allows the calculation of total contributions/earnings elasticity (Table 2, col. 5).

18. 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. Ten EU countries have unit elasticity, five 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 0.9 to just below 2, with an EU average of around 1¼ (Table 2, col. 6).

19. 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), 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 markedly in Sweden, the United Kingdom, Denmark and Luxembourg, with the Belgian and Irish elasticities, exceptionally, being revised up.

Output gap elasticities for personal income taxes and social security contributions

20. 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 approach as the 2005 study, in regressing changes in the ratio of earnings to potential GDP on changes in the output gap. However, the econometric specification is based on an error correction model, 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).

21. The elasticities of PIT and social security contributions relative to the output gap are shown in Table 5. The earnings/gap elasticities average 0.74 for the EU (col. 2), with a value of 1.2 for self-employment income (col. 3), though with greater dispersion. Capital income is generally significantly more responsive to the cycle, with an average elasticity of 3½ (col. 4). Cross-country differences are fairly marked. The resultant PIT/output gap elasticities average 1.7 for the EU (col. 1), which is somewhat higher than in the 2005 model, largely on account of the greater cyclical sensitivity of capital income (Annex Table A1.13 cols. 1 and 2). Moreover, there are quite important revisions for individual countries.

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

New methodology

	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]
Austria	1.66	0.70	0.85	3.75	1.40	1.57	6.35	0.65	0.92	0.70
Belgium	1.31	0.61	1.01	3.99	1.00	1.41	6.74	0.71	1.15	0.61
Bulgaria	1.15	0.66	1.23	3.50	0.70	1.26	5.60	0.61	0.93	0.66
Croatia	1.71	0.71	1.33	3.50	1.25	2.28	5.60	0.70	1.00	0.71
Cyprus	2.28	0.91	0.58	3.50	2.10	1.32	5.60	0.91	1.00	0.91
Czech Republic	1.65	0.87	0.00	2.21	1.95	0.00	3.90	0.86	0.99	0.87
Denmark	1.00	0.59	1.28	1.50	0.84	1.78	2.08	0.41	0.70	0.59
Estonia	1.58	1.03	0.88	4.17	1.51	1.27	6.07	1.40	1.36	1.03
Finland	1.41	0.77	1.13	3.34	1.15	1.62	4.41	0.77	1.00	0.77
France	1.86	0.66	1.45	4.02	1.14	2.44	5.55	0.63	0.95	0.66
Germany	1.87	0.70	1.90	1.32	1.32	3.55	2.30	0.60	0.86	0.70
Greece	2.22	0.69	1.29	3.75	1.59	2.75	5.96	0.58	0.84	0.69
Hungary	1.73	0.77	1.11	3.50	1.41	1.93	5.24	0.76	0.99	0.77
Ireland	1.58	0.69	1.07	3.05	1.46	1.73	5.52	1.04	1.51	0.69
Italy	1.46	0.60	0.84	3.28	1.10	1.58	5.73	0.58	0.97	0.60
Latvia	1.50	0.81	1.52	3.50	1.04	1.88	5.60	0.81	1.00	0.81
Lithuania	1.79	1.04	0.84	3.50	1.51	1.18	5.60	1.04	1.00	1.04
Luxembourg	1.34	0.44	1.37	3.50	1.00	2.63	6.50	0.39	0.89	0.44
Malta	2.07	0.76	1.22	3.50	1.65	2.58	5.60	0.71	0.92	0.76
Netherlands	2.37	0.73	2.20	4.86	1.57	4.04	5.83	0.62	0.86	0.73
Poland	1.88	0.99	0.58	3.50	1.94	1.06	5.30	0.97	0.97	0.99
Portugal	1.97	0.79	1.11	4.37	1.76	1.92	8.33	0.79	1.00	0.79
Romania	1.29	0.62	1.17	3.50	0.84	1.52	5.60	0.62	0.99	0.62
Slovak Republic	1.93	0.75	0.92	4.26	1.85	2.02	8.24	0.89	1.19	0.75
Slovenia	1.63	0.66	1.32	3.71	1.42	2.89	6.08	0.66	1.00	0.66
Spain	1.84	0.88	0.98	4.55	1.69	1.44	8.33	0.72	0.82	0.88
Sweden	1.32	0.75	1.22	2.66	1.09	1.47	3.11	0.71	0.95	0.75
United Kingdom	1.68	0.50	2.74	4.21	0.74	4.08	6.24	0.60	1.20	0.50
European Union	**1.68**	**0.74**	**1.22**	**3.50**	**1.36**	**1.97**	**5.61**	**0.74**	**1.00**	**0.74**

1. Income component tax-weighted average (average of columns 5 to 7). See Annex A1.2 column 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.

2. Corporate income taxes

22. 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 the 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.[13]

23. 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 rate (Table A1.3). There are no controls to exclude the effects of asset price inflation, so that the tax elasticities could include the impact of coincident capital gains, as well as profits.[14]

24. 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 around 1.8 on average for the EU (Table 6, col. 2), a feature of the analysis being the rather wide range of elasticities (from around unity to just under 3). Dispersion is probably to be more expected than a uniform elasticity response.[15] Combining these tax elasticities with tax base/output gap elasticities which are generally above unity (col. 3), the average corporation tax elasticity is around 2.3 for the EU (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. 5). 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).

13. 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.

14. 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).

15. 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 is unclear.

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	Tax base / output gap
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Austria	2.74	1.90	1.44	1.69	1.05	1.40	-0.35
Belgium	2.48	1.62	1.53	1.57	0.91	0.96	-0.05
Bulgaria[1]	2.13	1.81	1.18	..	..	..	..
Croatia[1]	2.29	1.81	1.27	..	..	..	..
Cyprus	2.26	1.93	1.17	..	..	..	..
Czech Republic	1.78	1.23	1.45	1.39	0.39	0.32	0.07
Denmark	3.15	2.07	1.52	1.65	1.50	1.70	-0.20
Estonia[1]	1.78	1.81	0.99	..	..	0.80	..
Finland	2.03	1.63	1.25	1.64	0.39	0.90	-0.52
France	2.76	2.03	1.36	1.59	1.17	1.52	-0.35
Germany	1.91	1.59	1.20	1.53	0.38	0.81	-0.42
Greece[1]	1.90	1.81	1.05	1.08	0.81	0.86	-0.05
Hungary[1]	2.21	1.81	1.22	1.44	0.77	1.08	-0.31
Ireland	1.25	1.00	1.26	1.30	-0.05	0.00	-0.05
Italy	3.07	2.09	1.47	1.12	1.95	1.41	0.53
Latvia	1.99	1.89	1.05	..	..	..	..
Lithuania	1.67	1.68	0.99	..	..	..	..
Luxembourg[1]	2.36	1.81	1.30	1.75	0.62	1.24	-0.62
Malta[1]	2.11	1.81	1.17	..	..	..	..
Netherlands	3.13	2.81	1.11	1.52	1.61	2.39	-0.78
Poland	2.92	2.30	1.27	1.39	1.53	1.73	-0.19
Portugal	1.33	1.07	1.24	1.17	0.16	0.09	0.08
Romania[1]	2.02	1.81	1.11	..	..	..	..
Slovak Republic	1.58	1.24	1.28	1.32	0.26	0.31	-0.04
Slovenia	3.76	2.72	1.38	..	..	..	..
Spain	1.56	1.32	1.18	1.15	0.41	0.37	0.04
Sweden	1.56	1.19	1.30	1.78	-0.23	0.30	-0.53
United Kingdom	3.92	2.89	1.35	1.66	2.26	2.85	-0.59
European Union	**2.27**	**1.81**	**1.25**	**1.46**	**0.84**	**1.05**	**-0.23**

1. Non statistically significant estimates (NS) or missing values (NA) are set to the EU 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.

3. Indirect taxes

25. Indirect tax accounts for around 35% of EU government revenues, of which around two-thirds is 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, which effectively means that indirect taxes are not subject to cyclical adjustment. However, 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).[16]

16. 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).

- 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.[17] Around one half of EU 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.

- 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, converging in around one year to a long term value lying between 1.0 and 1.1 (Princen and Mourre, 2014).

26. With the above considerations in mind, the possible biases involved in imposing indirect tax/consumption elasticities of unity have been assessed by estimating the elasticities from time series data.[18] 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 (to a degree) by including the standard rate of VAT as a variable to control for tax shifts. 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. The regressions deliver a set of short-term elasticities which range of 0.8 to 1.2, with Slovenia, Hungary, and Spain the outliers, and a clustering around unity (Table 7).

17. 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 GFCF in the national accounts.

18. No controls are possible for excise rate changes, the elasticities relating to which will include any indexing of rates that takes place

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

	Estimated tax/consumption elasticity [1]	Applied tax / output gap elasticity
Austria	0.94	1.00
Belgium [1]	0.97	1.00
Bulgaria [1]	0.97	1.00
Croatia [1]	0.97	1.00
Cyprus [1]	0.97	1.00
Czech Republic	1.08	1.00
Denmark	0.97	1.00
Estonia	0.77	1.00
Finland	1.16	1.00
France [1]	0.97	1.00
Germany	0.80	1.00
Greece	0.81	1.00
Hungary	0.61	1.00
Ireland	1.18	1.00
Italy [1,2]	0.97	1.10
Latvia [1]	0.97	1.00
Lithuania [1]	0.97	1.00
Luxembourg [1]	0.97	1.00
Malta	0.97	1.00
Netherlands	0.78	1.00
Poland	1.14	1.00
Portugal	0.89	1.00
Romania [1]	0.97	1.00
Slovak Republic	1.10	1.00
Slovenia	0.63	1.00
Spain	1.48	1.00
Sweden	1.19	1.00
United Kingdom	1.04	1.00
European Union	**0.97**	**1.00**

1. Not statistically significant estimates (NS) or missing values (NA) are set to the EU average. See Annex table A1.4 for detailed calculations.

2. Exceptions apply to Italy, see explanations in the main text.

Source: OECD calculations.

27. While there are reasons to think that this elasticity could actually depart from one and differ across countries, the significant cross-country differences described above are difficult to trace back to differences in tax codes. More generally, providing elasticity estimates which are statistically robust and consistent with clear economic rationales, while also being a reliable gauge for cyclically adjusting indirect taxes going forward, is challenging. The equations attempt to control the financial crisis by using a dummy, but the estimated elasticities may still be affected by special factors which would not necessarily recur -- at least not in the same form as in the past. 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). Insofar as the estimated indirect

tax elasticities are correlated with structural shifts in tax efficiency,[19] their reliability for cyclical adjustment purposes is called into question and as a result a unit elasticity has continued to be imposed.

28. There is also the problem of what consumption/output gap elasticity to apply to calculate the indirect tax/output gap elasticity. 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 the equations would need to control for government consumption (since government spending is assumed constant) and investment (the capital stock being assumed constant). The consumption/output gap elasticity would vary from country to country according to whether demand is domestically or externally led (which would affect the indirect tax to output gap elasticity since exports are not taxed). This, however, is a normative issue, and at least on average, there also seems to be some justification for continuing with the expedient of using unit indirect tax/output gap elasticity for cyclical adjustment purposes. This means that the indirect tax/output gap elasticity is equal to the indirect tax/consumption elasticity (Table 7, col. 2). There is one exception: in the Italian case, the tax base for the IRAP, which is classified as an indirect tax, is broader than and different from consumption, displaying an elasticity with respect to output above unity; here the indirect tax base/output elasticity is set at 1.1.[20]

4. Non-tax revenues

29. Non-tax revenues amount to around 2½ per cent of GDP, or 11% 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 incomes -- 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-EU 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 revenue are not related to cycle (Annex Table A1.5).

IV. Government expenditure elasticities

1. Unemployment related spending

30. 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 of the *i*th category of government spending ($\varepsilon_{gi,y}$) into two components: *i)* the elasticity of expenditures with respect to their base ($\varepsilon_{gi,gbi}$), and *ii)* the elasticity of bases with respect to output ($\varepsilon_{gbi,y}$):

$$\varepsilon_{gi,y} = \varepsilon_{gi,gbi} \cdot \varepsilon_{gbi,y} \qquad (4)$$

In this case, the only items of spending that are involved are transfers which respond to unemployment or income; discretionary spending is, by definition, taken as exogenous, as are interest payments on the national debt.

19. The correlation between the indirect tax elasticities and the change in compliance between 2007 and 2009, for example, is 0.35.

20. *Imposta regionale sulle attività produttive* is a regional tax on productive activities.

Table 8. Summary of revenue elasticities with respect to the output gap

	Aggregate tax elasticity (tax weighted average)	Tax revenue to output gap elasticties				Tax weights as % of GDP				
		Income tax[1]	Corporate tax[2]	Indirect tax[3]	Social security contributions[4]	Total	Income tax	Corporate tax	Indirect tax	Social security contributions
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Austria	1.12	1.66	2.74	1.00	0.65	44.4	11.0	2.3	14.5	16.6
Belgium	1.09	1.31	2.48	1.00	0.71	46.6	13.6	3.3	12.9	16.8
Bulgaria	0.97	1.15	2.13	1.00	0.61	27.4	3.8	1.2	15.2	7.2
Croatia	1.05	1.71	2.29	1.00	0.70	35.8	4.6	1.5	18.2	11.5
Cyprus	1.39	2.28	2.26	1.00	0.91	34.5	8.4	2.7	14.9	8.5
Czech Republic	1.08	1.65	1.78	1.00	0.86	35.7	4.0	3.3	12.5	15.8
Denmark	1.12	1.00	3.15	1.00	0.41	49.2	27.2	3.3	16.7	1.9
Estonia	1.28	1.58	1.78	1.00	1.40	33.6	5.8	1.5	14.5	11.9
Finland	1.12	1.41	2.03	1.00	0.77	43.9	13.5	2.5	14.7	13.2
France	1.13	1.86	2.76	1.00	0.63	47.9	10.2	2.6	15.6	19.5
Germany	1.10	1.87	1.91	1.00	0.60	40.5	9.4	2.8	11.4	17.0
Greece	1.13	2.22	1.90	1.00	0.58	36.0	6.1	3.3	12.6	14.0
Hungary	1.07	1.73	2.21	1.00	0.76	38.0	5.4	1.4	18.5	12.7
Ireland	1.23	1.58	1.25	1.00	1.04	29.9	10.4	2.6	11.2	5.8
Italy[4]	1.15	1.46	3.07	1.10	0.58	44.4	12.8	2.4	15.4	13.8
Latvia	1.11	1.50	1.99	1.00	0.81	39.6	8.3	2.6	16.4	12.3
Lithuania	1.15	1.79	1.67	1.00	1.04	27.3	3.7	1.2	11.1	11.3
Luxembourg	1.12	1.34	2.36	1.00	0.39	39.2	7.2	7.2	12.7	12.1
Malta	1.37	2.07	2.11	1.00	0.71	34.5	10.4	3.3	13.4	7.4
Netherlands	1.26	2.37	3.13	1.00	0.62	39.5	8.8	2.1	12.1	16.5
Poland	1.26	1.88	2.92	1.00	0.97	33.2	4.9	2.4	13.1	12.8
Portugal	1.13	1.97	1.33	1.00	0.79	33.8	6.1	2.8	13.4	11.6
Romania	0.98	1.29	2.02	1.00	0.62	28.3	4.6	1.5	13.2	9.0
Slovak Republic	1.11	1.93	1.58	1.00	0.89	29.2	3.1	2.7	10.0	13.4
Slovenia	1.01	1.63	3.76	1.00	0.66	37.4	6.5	0.6	14.8	15.5
Spain	1.13	1.84	1.56	1.00	0.72	32.9	7.8	2.3	10.3	12.5
Sweden	1.10	1.32	1.56	1.00	0.71	44.7	15.6	2.7	18.7	7.7
United Kingdom	1.37	1.68	3.92	1.00	0.60	37.1	12.0	3.0	13.5	8.5
European Union	**1.15**	**1.68**	**2.27**	**1.00**	**0.74**	**37.3**	**8.8**	**2.5**	**14.0**	**12.0**

1. Table 5 column 1.
2. Table 6 column 1.
3. Table 7 column 2.
4. Table 5 column 8.

Source: OECD calculations.

31. In the 2005 model, the only element of spending defined as cyclically sensitive was unemployment-related spending. Originally, three categories of unemployment-related expenditure were covered: subsidised employment, unemployment compensation and early retirement for labour market reasons, but uneven data coverage prevented the uniform treatment of subsidised employment and early retirement. A unit elasticity was therefore assumed between unemployment-related expenditure and unemployment. The unemployment/output gap elasticity was empirically estimated and could be thought of as a reduced form relationship, capturing variations in employment with respect to output and in the labour force with respect to employment.

32. Re-estimation yields overall elasticity results close to the previous numbers on average, though with significant revisions for certain countries (Table 9, cols. 1 to 3 and Table A1.11). These revisions probably reflect the intervening employment histories, as well as the resulting levels of unemployment-related government spending. 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. The average of estimated elasticities is about 0.80, with country estimates mostly concentrated around 0.60, partly reflecting the compositional effect for some countries, while some others are found to be close to unity (see Annex Table A1.12). There remain a few exceptions requiring some caution in interpreting the results. However, whether a unitary elasticity still holds needs to be tested by empirical analysis.

2. Income-related benefits

33. 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 data set that allows for the analysis of personal income taxes and social security contributions also provides information on these types of benefit, 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:

$$\varepsilon_{ben,ye} = \frac{\sum \omega_{ye,i} \cdot mrb_i}{\sum \omega_{ye,i} \cdot arb_i} \qquad (5)$$

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

34. The results are given in Table 9 (cols. 4 to 7). Again, the range is quite wide, from zero to around -1.2 in the EU area. The ratio of earnings-related benefits to gross earnings is around 10% for the EU on average, ranging up to 40% for Denmark and Sweden. The elasticities can be combined with earnings/output gap elasticities to derive an elasticity of income-related benefits with respect to the output gap (cols. 6 and 7).

35. Given the high and difficult to explain dispersion across countries in the empirical estimates for income-related benefits, the latter were not retained as a cyclical expenditure item. The only item actually included in the cyclical adjustment procedure thus remains unemployment benefits. In respect of these, the conventional assumption of a unit elasticity *vis-à-vis* the benefit rate and unemployment has been maintained, though there is some evidence that this may be misleading in some cases.

Table 9. Government expenditure elasticities

	Unemployment related transfers			Earnings related social transfers			
	Share of unemployment related spending in total current primary expenditure	Output elasticity of unemployment	Output elasticity of unemployment-related spending relative to output gap[1]	Share of earnings-related social benefits in total current primary expenditures	Benefits-to-earnings elasticity	Earnings-to-output elasticity[2]	Elasticity of social benefits relative to output gap[3]
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Austria	3.51	-4.71	-4.71	7.31	-0.73	0.70	-0.51
Belgium	7.60	-3.70	-3.70	6.47	-0.56	0.61	-0.34
Bulgaria[1]	1.54	-3.91	-3.91	7.06	-0.39	0.66	-0.26
Croatia	1.09	-2.39	-2.39	4.21	0.00	0.71	0.00
Cyprus	2.77	-3.08	-3.08	7.06	0.00	0.91	0.00
Czech Republic	2.50	-2.45	-2.45	4.03	-0.95	0.87	-0.83
Denmark	2.95	-4.97	-4.97	11.00	-1.20	0.59	-0.70
Estonia	3.12	-5.18	-5.18	6.40	-0.53	1.03	-0.55
Finland	4.57	-3.66	-3.66	8.26	-1.02	0.77	-0.79
France	3.97	-3.23	-3.23	7.86	-1.02	0.66	-0.67
Germany	4.29	-3.30	-3.30	9.52	-0.92	0.70	-0.64
Greece	3.89	-3.15	-3.15	6.69	0.00	0.69	0.00
Hungary	2.32	-1.25	-1.25	9.04	-0.82	0.77	-0.63
Ireland	8.99	-5.45	-5.45	12.72	0.00	0.69	0.00
Italy	1.68	-2.29	-2.29	3.38	0.00	0.60	0.00
Latvia	4.99	-3.94	-3.94	5.74	-0.67	0.81	-0.54
Lithuania	3.12	-5.60	-5.60	9.76	-0.73	1.04	-0.76
Luxembourg	3.44	-3.06	-3.06	7.06	-1.03	0.44	-0.45
Malta	1.72	-1.96	-1.96	4.64	-0.92	0.76	-0.71
Netherlands	3.02	-5.76	-5.76	7.76	-0.86	0.73	-0.63
Poland	1.07	-6.18	-6.18	3.01	-1.14	0.99	-1.14
Portugal	3.54	-6.04	-6.04	4.20	-0.70	0.79	-0.55
Romania[1]	1.29	-3.91	-3.91	6.08	-0.41	0.62	-0.25
Slovak Republic	2.95	-2.98	-2.98	6.03	-0.76	0.75	-0.57
Slovenia	1.35	-2.81	-2.81	5.80	-0.93	0.66	-0.61
Spain	10.40	-5.83	-5.83	4.88	-0.51	0.88	-0.45
Sweden	2.59	-4.42	-4.42	8.68	-1.22	0.75	-0.92
United Kingdom	1.96	-4.21	-4.21	8.13	-0.93	0.50	-0.46
European Union	**3.44**	**-3.91**	**-3.91**	**7.06**	**-0.69**	**0.77**	**-0.54**

1. Equals to output elasticity of unemployment. Non statistically significant estimates (NS) or missing values (NA) are set to the EU average.
2. Refer to adjusted elasticities. See Annex Table A1.10 and Annex for methodology.
3. Equals to the product of two previous columns.
Source: OECD calculations.

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METHODOLOGICAL AND STATISTICAL ANNEX

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

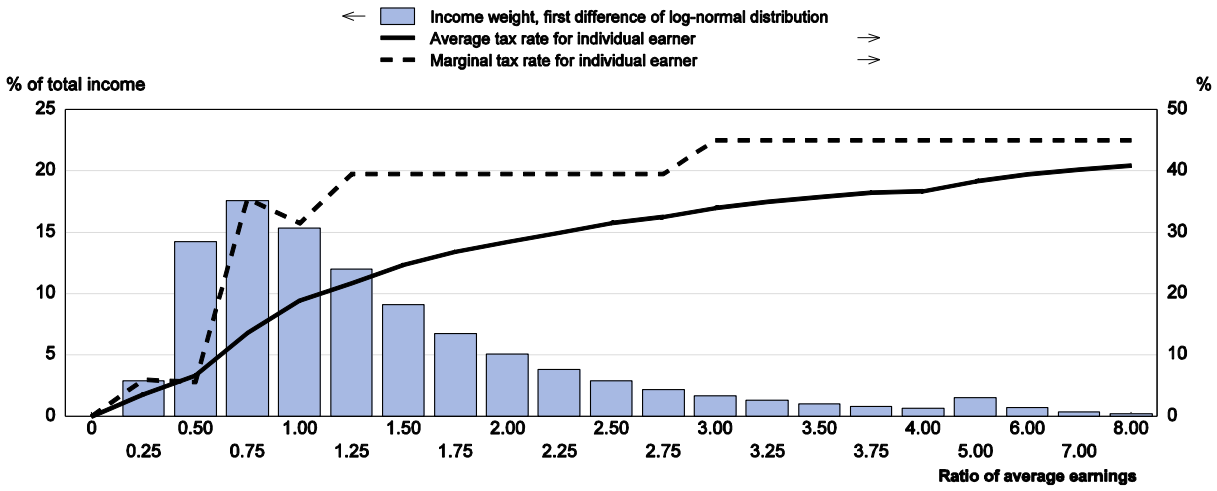
Elasticities with respect to earnings

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 (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):

$$\varepsilon_{t,ye} = \frac{MR}{AR} = \frac{\sum \omega_{ye,i} \cdot mr_i}{\sum \omega_{ye,i} \cdot ar_i} \qquad \text{(A1)}$$

where $\varepsilon_{t,ye}$ is the aggregate tax (social security contribution) elasticity with respect to earnings (*ye*), mr_i is the marginal rate at point *i* on the earnings distribution, ar_i is the average rate, $\omega_{ye,i}$ is 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.

Annex Table A1.1. Derivation of weighted average elasticity from individual tax codes

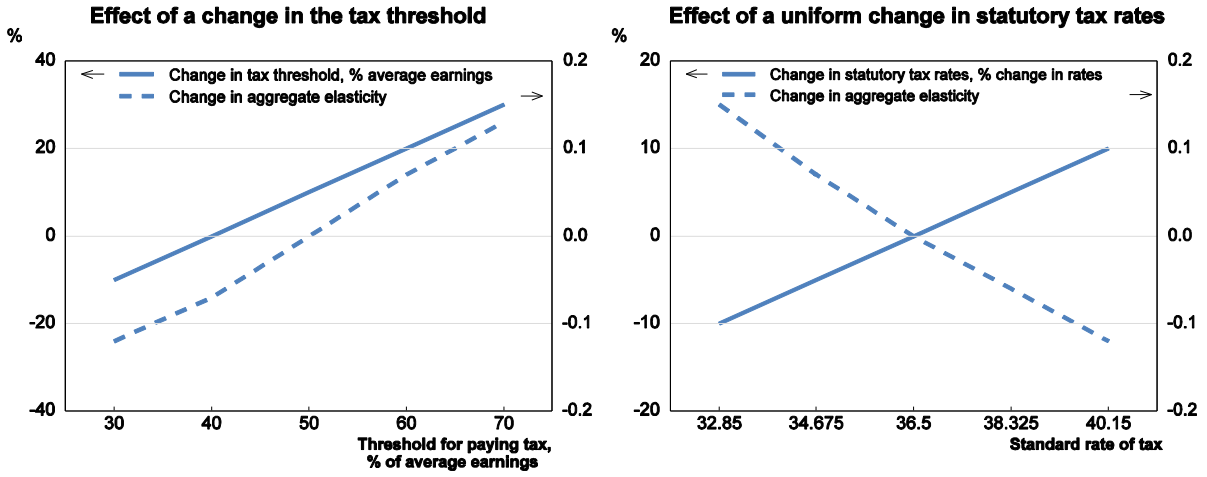
Income as a ratio of average earnings	Tax rate for individual earner		Tax elasticity facing individual	Log-normal income distribution	Income-weighted aggregate		
	Average rate	Marginal rate			First difference of log-normal distribution	Marginal rate	Average rate
1	2	3	4	5	6	7	8
0.00	0.00	0.00	0.00	0.00	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
Average						**0.20**	**0.32**
Aggregate elasticity (col. 8/col.7)						**1.60**	

Source: OECD calculations; example based on Australian tax system.

2. The aggregate elasticity will depend particularly on the distribution of income around the first income tax bracket (i.e. the 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 decrease 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.[21] This is not so crucial for social security contributions, which is usually proportional up to a certain ceiling.

21. 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

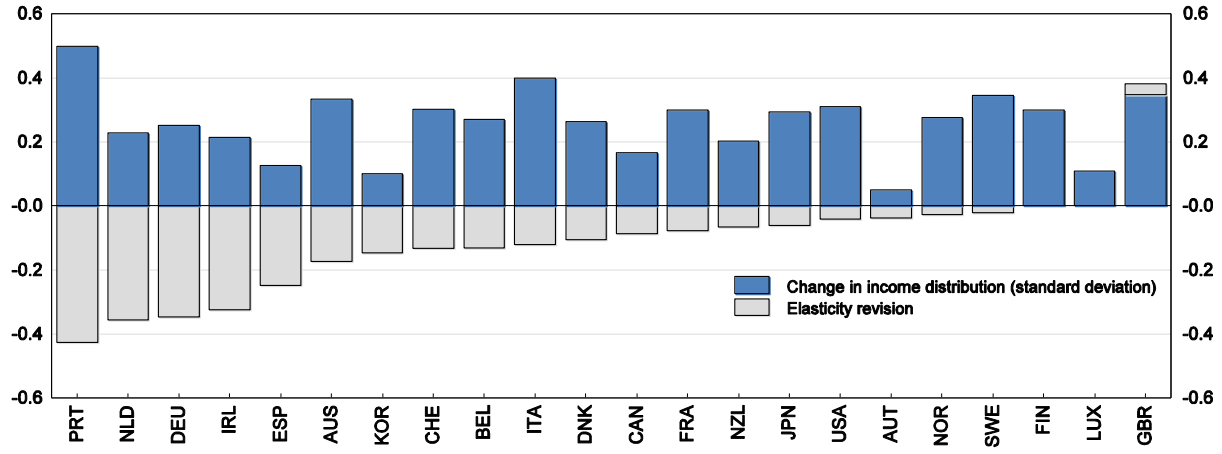


Source: OECD calculations.

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.

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).

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



Source: OECD calculations.

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.[22] The coverage includes 27 of the 28 EU members (except Croatia). 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 *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 *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).

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.

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

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 *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 *Distribution and Poverty* data set, using the same method as for earnings:

$$\varepsilon_{k,b} = \frac{MR_k}{AR_k} = \frac{\sum \omega_{k,i} \cdot mr_i}{\sum \omega_{k,i} \cdot ar_i} \qquad \text{(A2)}$$

where $\varepsilon_{k,b}$ is the elasticity of tax on income component *k* with respect to its base, $\omega_{k,i}$ is the income of the *k*th income category of income tax at income-level *i* in total *k*th income, mr_i and ar_i are the marginal and average tax rates by income level, and MR_k and AR_k are the weighted marginal and average tax rates.[23] 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 *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.

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.[24] This applies to the majority of EU 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

23. Self-employment income recipients 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.

24. 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.

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.)

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

	Tax revenue to tax base elasticities				Tax base to output gap elasticities[2]				Tax revenue to output gap elasticities					Tax weights		
	Earnings	Self employed	Capital income	**Personal income tax**[1]	Earnings	Self employed	Capital income[3]	**Personal income tax**[1]	Earnings	Self-employment	Capital income	**Personal income tax**[1]	Personal income tax (col 4 x col 8)	Earnings	Self employed	Capital income
	[1]	[2]	[3]	**[4]**	[5]	[6]	[7]	**[8]**	[9]	[10]	[11]	**[12]**	[13]	[14]	[15]	[16]
Austria	2.00	1.85	1.70	**1.97**	0.70	0.85	3.75	**0.86**	1.40	1.57	6.35	**1.66**	1.70	0.61	0.10	0.04
Belgium	1.63	1.39	1.69	**1.62**	0.61	1.01	3.99	**0.81**	1.00	1.41	6.74	**1.31**	1.30	0.68	0.07	0.04
Bulgaria	1.07	1.02	1.60	**1.11**	0.66	1.23	3.50	**0.95**	0.70	1.26	5.60	**1.15**	1.05	0.65	0.10	0.06
Croatia	1.77	1.72	1.60	**1.75**	0.71	1.33	3.50	**1.00**	1.25	2.28	5.60	**1.71**	1.74	0.65	0.10	0.06
Cyprus	2.31	2.27	1.60	**2.25**	0.91	0.58	3.50	**1.07**	2.10	1.32	5.60	**2.28**	2.41	0.65	0.10	0.06
Czech Republic	2.24	2.24	1.77	**2.23**	0.87	0.00	2.21	**0.75**	1.95	0.00	3.90	**1.65**	1.67	0.63	0.14	0.02
Denmark	1.44	1.38	1.39	**1.43**	0.59	1.28	1.50	**0.70**	0.84	1.78	2.08	**1.00**	1.01	0.71	0.05	0.07
Estonia	1.46	1.45	1.46	**1.46**	1.03	0.88	4.17	**1.08**	1.51	1.27	6.07	**1.58**	1.58	0.76	0.02	0.01
Finland	1.50	1.43	1.32	**1.48**	0.77	1.13	3.34	**0.97**	1.15	1.62	4.41	**1.41**	1.44	0.65	0.06	0.05
France	1.73	1.69	1.38	**1.68**	0.66	1.45	4.02	**1.19**	1.14	2.44	5.55	**1.86**	2.00	0.58	0.06	0.10
Germany	1.90	1.87	1.74	**1.88**	0.70	1.90	1.32	**1.00**	1.32	3.55	2.30	**1.87**	1.88	0.57	0.17	0.06
Greece	2.30	2.14	1.59	**2.21**	0.69	1.29	3.75	**1.07**	1.59	2.75	5.96	**2.22**	2.35	0.49	0.22	0.05
Hungary	1.84	1.74	1.50	**1.80**	0.77	1.11	3.50	**0.99**	1.41	1.93	5.24	**1.73**	1.78	0.47	0.07	0.04
Ireland	2.11	1.61	1.81	**2.04**	0.69	1.07	3.05	**0.79**	1.46	1.73	5.52	**1.58**	1.61	0.60	0.09	0.01
Italy	1.84	1.89	1.75	**1.85**	0.60	0.84	3.28	**0.80**	1.10	1.58	5.73	**1.46**	1.47	0.49	0.21	0.04
Latvia	1.29	1.24	1.60	**1.31**	0.81	1.52	3.50	**1.10**	1.04	1.88	5.60	**1.50**	1.44	0.65	0.10	0.06
Lithuania	1.45	1.40	1.60	**1.46**	1.04	0.84	3.50	**1.21**	1.51	1.18	5.60	**1.79**	1.76	0.65	0.10	0.06
Luxembourg	2.28	1.92	1.86	**2.24**	0.44	1.37	3.50	**0.63**	1.00	2.63	6.50	**1.34**	1.41	0.67	0.05	0.03
Malta	2.16	2.11	1.60	**2.11**	0.76	1.22	3.50	**1.03**	1.65	2.58	5.60	**2.07**	2.18	0.65	0.10	0.06
Netherlands	2.15	1.84	1.20	**2.00**	0.73	2.20	4.86	**1.42**	1.57	4.04	5.83	**2.37**	2.83	0.67	0.08	0.11
Poland	1.96	1.84	1.51	**1.93**	0.99	0.58	3.50	**0.99**	1.94	1.06	5.30	**1.88**	1.90	0.64	0.12	0.02
Portugal	2.22	1.73	1.91	**2.15**	0.79	1.11	4.37	**0.93**	1.76	1.92	8.33	**1.97**	2.01	0.66	0.09	0.02
Romania	1.35	1.30	1.60	**1.36**	0.62	1.17	3.50	**0.91**	0.84	1.52	5.60	**1.29**	1.24	0.65	0.10	0.06
Slovak Republic	2.47	2.20	1.93	**2.43**	0.75	0.92	4.26	**0.80**	1.85	2.02	8.24	**1.93**	1.95	0.68	0.09	0.01
Slovenia	2.15	2.19	1.64	**2.14**	0.66	1.32	3.71	**0.77**	1.42	2.89	6.08	**1.63**	1.66	0.71	0.05	0.02
Spain	1.93	1.48	1.83	**1.88**	0.88	0.98	4.55	**0.99**	1.69	1.44	8.33	**1.84**	1.85	0.67	0.08	0.02
Sweden	1.45	1.21	1.17	**1.42**	0.75	1.22	2.66	**0.97**	1.09	1.47	3.11	**1.32**	1.38	0.68	0.03	0.08
United Kingdom	1.50	1.49	1.48	**1.49**	0.50	2.74	4.21	**1.13**	0.74	4.08	6.24	**1.68**	1.68	0.67	0.08	0.09
European Union	**1.84**	**1.70**	**1.60**	**1.81**	**0.74**	**1.22**	**3.50**	**0.96**	**1.36**	**1.97**	**5.61**	**1.68**	**1.72**	**0.64**	**0.09**	**0.05**

1. The difference between columns 12 and 13 (or why column 12 is not exactly equal to column 4 times column 8) is due to tax weights (in columns 14 to 16) not summing up to one exactly, as public transfers were removed from the gross personal income tax base (because in some countries they are not taxable). In Mourre et al. (2014), the aggregate elasticity of the personal income tax base to the output gap (column 8) was rescaled so that when multiplied with the aggregate elasticity of tax revenue to base (column 4), the result corresponds to column 12.

2. For earnings and self-employment, output gap elasticities refer to adjusted elasticties. See Annex Table A1.10 for detailed calculations.

3. See Annex Table A1.9 for detailed estimations of capital income to output gap elasticities. Non statistically significant estimates (NS) or missing values (NA) are set to the EU average.

Source: OECD calculations.

II. ESTIMATING INDIRECT AND CORPORATE TAX ELASTICITIES

13. As discussed in the text, for corporation and indirect taxes the approach adopted is to estimate the tax elasticities directly from time series data. The analysis uses a model with an error correction term (ECT), following the approach of Bruce et al. (2006) and Wolswijk (2007). Unlike a first-difference model, an ECT 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 error correction model, the tax equation is expressed as follows:

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

where the second-to-last term is called the error correction term (ECT). Substituting (2) into (1') gives :

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

The non-linear log form is the following:

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

Box A1. Cyclical adjustment in the ECT model (Cont.)

- 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:

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

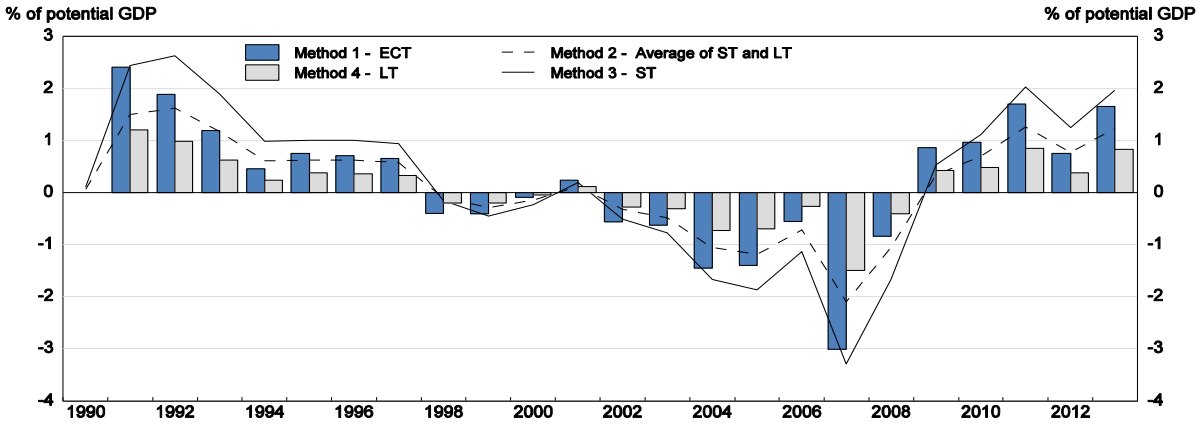
The lagged effects apply to the output gap in (t-1) and relate to that part corrected (λ) in (t) due to the deviation of tax revenues from its long run trend (β) in the preceding year.

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 + λ(ST-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 + λ(ST-LT) + λ(ST + λ(ST-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 along with two others: a first difference Generalised Least Square specification allowing for a correction of first order AR(1) autocorrelation in the residuals and a specification where the ECT also controls for any 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.

Figure A1.4. Cyclical adjustment under an ECT model

Adjustment as a percentage of potential GDP



Source: OECD calculations.

16. Model selection is based on several criteria. First, the R Squared 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 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 EU average.

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

Period 1990-2013

	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
	Tax elasticity	Short term	Long term	3 year average of ST and LT[2]	R^2 adj.	Model[3]	ECT	2d year	3d 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	
Austria	1.90	2.41	1.34	1.90	0.36	[2]	-0.60	1.77	1.52	1.90	3.43 *	0.04	0.17	2.13	0.16	2.41 *	-0.21	-0.60 **	0.80 *	0.36	1.97	0.14	2.31 *	-0.24	-0.65	0.85	0.32	1.92	0.15	22
Belgium[4]	1.62	1.73	1.22	1.62	0.20	[2]	-0.23	1.61	1.52	1.62	2.46 **	1.12 *	0.22	1.48	0.11	1.73 *	0.44	-0.23	0.28	0.20	2.17	0.11	2.20 **	0.80	-0.13	0.16	0.17	1.44	0.11	22
Bulgaria[5]	1.81	..	..	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4
Croatia	1.81	..	..	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4
Cyprus	1.93	2.30	1.32	1.93	0.57	[2]	-0.43	1.87	1.63	1.93	3.05 **	0.15	0.52	2.12	0.13	2.30 **	0.24	-0.43 *	0.57 *	0.57	2.08	0.12	2.84 **	0.34 *	-0.36 *	0.52 *	0.56	2.22	0.13	16
Czech Republic	1.23	1.29	1.11	1.23	0.24	[2]	-0.37	1.22	1.18	1.23	0.85 *	1.11 *	0.11	1.85	0.11	1.29 *	0.99	-0.37 *	0.41 *	0.24	2.29	0.11	1.94 **	0.91	-0.29	0.39 *	0.17	1.60	0.11	19
Denmark	2.07	2.28	1.37	2.07	0.72	[2]	-0.25	2.06	1.89	2.07	2.80 **	0.30	0.57	2.30	0.11	2.28 **	0.85	-0.25	0.34	0.72	1.82	0.09	2.63 **	0.06	-0.21	0.35	0.57	2.24	0.11	22
Estonia[5]	1.81	..	..	..	..	NS	0.00	0.00	0.00	0.00	-0.04	2.49	-0.18	1.42	0.28	-0.49	0.42	-0.83 **	0.84 *	0.44	1.38	0.19	-0.60	1.50	-0.94 *	0.73 *	0.56	1.90	0.17	12
Finland	1.63	2.31	0.20	1.63	0.90	[3]	-0.37	1.53	1.03	1.63	3.88 **	0.27	0.48	1.54	0.24	2.80 **	0.56	-0.28 **	0.09	0.75	2.62	0.17	2.31 **	0.57	-0.37 **	0.08	0.90	1.57	0.11	19
France[6]	2.03	2.19	1.75	2.03	0.79	[2]	-0.42	2.01	1.90	2.03	5.45 **	0.56	0.38	1.95	0.17	2.19 *	0.39	-0.42 **	0.84 **	0.79	1.70	0.10	5.89 **	0.07	-0.50 *	0.87 *	0.55	1.88	0.15	22
Germany	1.59	2.15	0.80	1.59	0.47	[2]	-0.50	1.48	1.14	1.59	1.79 *	0.56 *	0.21	1.88	0.15	2.15 *	0.50 *	-0.50 **	0.40 *	0.47	1.26	0.15	1.65 *	0.43	-0.53	0.59	0.37	1.93	0.13	22
Greece[5]	1.81	..	..	..	..	NS	0.00	0.00	0.00	0.00	0.28	0.00	-0.22	1.79	0.12	-0.15	-0.12	-0.31	0.04	0.17	2.00	0.09	0.06	-0.17	-0.95	0.31	0.34	2.56	0.09	17
Hungary[5]	1.81	..	..	..	..	NS	0.00	0.00	0.00	0.00	0.48	1.78	0.09	1.80	0.23	-0.85	1.92 *	-0.34 *	0.01	0.33	1.46	0.19	-1.39	1.43	-0.50	-0.04	0.40	1.76	0.18	17
Ireland	1.00	1.08	0.73	1.00	0.64	[2]	-0.25	0.99	0.93	1.00	1.20 **	0.05	0.52	2.28	0.10	1.08 **	-0.14	-0.25 *	0.18	0.64	1.90	0.08	1.06 **	-0.16	-0.26	0.20	0.60	1.98	0.09	22
Italy[7]	2.09	2.05	2.62	2.09	0.33	[3]	-0.07	2.09	2.13	2.09	1.16 *	1.05 **	0.35	1.91	0.14	1.03	0.68	-0.47 *	0.31	0.31	2.25	0.14	2.05 *	1.09 *	-0.07	0.18	0.33	2.01	0.14	22
Latvia	1.89	1.89	-	0.00	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
Lithuania	1.68	1.81	1.51	1.68	0.24	[3]	-0.51	1.65	1.58	1.68	2.03 *	0.60	0.13	1.36	0.40	1.95 *	0.91	-0.40 *	0.63 *	0.20	1.21	0.38	1.81 *	0.64	-0.51	0.77	0.24	1.35	0.37	16
Luxembourg[5]	1.81	..	..	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6
Malta[5]	1.81	..	..	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Netherlands	2.81	3.41	0.51	2.81	0.55	[3]	-0.22	2.77	2.27	2.81	3.33 **	0.01	0.49	1.98	0.11	3.44 **	-0.29	-0.23 *	0.12	0.58	2.11	0.09	3.41 **	-0.38	-0.22 *	0.11	0.55	2.02	0.10	22
Poland	2.30	2.78	1.25	2.30	0.64	[2]	-0.36	2.23	1.88	2.30	2.50 **	-0.13	0.47	1.97	0.10	2.78 **	0.00	-0.36 *	0.45 **	0.64	1.60	0.08	2.61 **	-0.09	-0.38	0.45 *	0.62	1.79	0.09	17
Portugal	1.07	0.99	1.13	1.07	0.48	[3]	-0.78	1.10	1.12	1.07	1.10 **	-0.47	0.32	1.98	0.13	0.77 *	-0.29	-0.54 *	0.50 *	0.42	1.38	0.12	0.99 *	-0.05	-0.78	0.88	0.48	1.60	0.12	22
Romania[5]	1.81	..	..	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Slovak Republic	1.24	1.28	0.89	1.24	0.75	[3]	-0.13	1.23	1.19	1.24	1.34 **	0.48 **	0.66	2.28	0.05	1.31 **	0.39 **	-0.22	0.17 *	0.75	2.46	0.05	1.28 **	0.46 **	-0.13	0.12	0.75	2.08	0.05	17
Slovenia[8]	2.72	2.72	-	-	0.79	[1]	0.00	0.00	0.00	0.00	2.72 **	0.60	0.79	2.05	0.15	1.02	1.09	0.36	-1.33 *	0.68	2.32	0.18	0.52	1.37	0.40 *	-1.60 *	0.67	2.24	0.19	12
Spain	1.32	1.34	1.30	1.32	0.70	[3]	-0.74	1.31	1.30	1.32	2.17 *	1.63	0.17	2.02	0.17	2.40 *	0.88	-0.11	0.14	0.15	1.96	0.17	1.34 *	-2.19 *	-0.74 **	3.79 **	0.70	1.74	0.10	22
Sweden	1.19	1.18	1.21	1.19	0.53	[3]	-0.72	1.20	1.21	1.19	2.42 *	-0.52	0.05	1.37	0.20	1.08	2.33 **	-0.61 **	0.90 **	0.59	1.69	0.17	1.18 *	0.40	-0.72	0.87	0.53	1.87	0.14	22
United Kingdom	2.89	2.89	-	-	0.36	[1]	0.00	0.00	0.00	0.00	2.89 **	-1.29	0.36	2.12	0.12	2.81 *	-0.69	-0.23	0.39	0.37	1.40	0.12	1.84	-1.10	-0.48	0.62	0.37	1.96	0.12	22
European Union[9]	**1.81**	**0.00**	**0.00**	**0.00**	**0.54**		**-0.25**	**1.00**	**0.91**	**1.03**	**1.76**	**0.35**	**0.26**	**1.55**	**0.14**	**1.32**	**0.39**	**-0.29**	**0.27**	**0.38**	**1.53**	**0.12**	**1.48**	**0.15**	**-0.34**	**0.42**	**0.40**	**1.56**	**0.11**	**16**

Key: * Statistically significant at 10% level; ** Statistically significant at 5% level.

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. For Belgium, the statistically second-best model (2) is preferred .
5. Non statistically significant estimates or missing values are set to the EU average.
6. For France, dummy controls used to reflect discretionary measures introduced in 2008/09.
7. For Italy, model (3).
8. For Slovenia, the elasticity is set to the EU average, given the small sample (below 15 observation points).
9. Average calculated over coefficient estimates statistically significant.

Source: OECD calculations, OECD Economic Outlook 93, European Commission for EU7 non-OECD countries. Corporate tax data are from OECD Taxation and Taxation trends in the European Union edition 2013 (EUROSTAT).

Annex Table A1.4. Indirect tax to private consumption regressions

Period 1990-2013

	Indirect tax / private consumption short-term elasticity[1]										Mod1 AR(1), [1]						Mod2 ECT, [2]								Mod2 ECT + AR(1), [3]								N
	Tax elasticity	Short term	Long term	3 year average of ST and LT[2]	R^2 adj.	Model[3]	ECT	2d year	3d 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	
Austria	0.94	0.89	0.97	0.94	0.32	[2]	-0.79	0.95	0.97	0.94	0.66 *	nc	0.00	0.06	2.14	0.02	0.89 *	nc	-0.79 **	0.77 **	0.01	0.32	1.94	0.02	0.88 *	nc	-0.91	0.89	0.01	0.28	1.98	0.02	24
Belgium[3]	0.97	..	..	..	..	NS	0.00	0.00	0.00	0.00	0.30	0.58	-0.04 **	0.32	2.07	0.02	0.37	0.46	-0.11	0.12	-0.04 *	0.26	2.43	0.02	0.38	0.41	-0.09	0.09	-0.04 *	0.29	2.14	0.02	22
Czech Republic	1.08	0.96	1.32	1.08	0.29	[3]	-0.38	1.10	1.19	1.08	0.40	0.25	-0.03	0.00	1.76	0.03	1.17 **	0.36 *	-0.28	0.40 *	-0.05 *	0.40	2.29	0.03	0.96 *	0.26	-0.38	0.51 *	-0.05 *	0.29	1.96	0.03	17
Denmark	0.97	0.97	-	-	0.72	[1]	0.00	0.00	0.00	0.00	0.97 **	0.01	-0.04 **	0.72	2.09	0.02	0.93 **	0.01	-0.03	0.02	-0.04 *	0.66	1.69	0.02	1.04 **	-0.11	-0.07	0.05	-0.03 *	0.74	2.39	0.02	22
Estonia	0.77	0.77	-	-	0.34	[1]	0.00	0.00	0.00	0.00	0.77 **	0.03	0.01	0.34	2.19	0.07	0.82 **	0.38	-0.39	0.44	-0.02	0.47	2.43	0.07	0.58	0.14	-1.38 **	1.74 **	-0.21 *	0.51	1.93	0.06	17
Finland	1.16	1.16	-	-	0.35	[1]	0.00	0.00	0.00	0.00	1.16 **	nc	-0.02	0.35	1.93	0.03	1.20 **	nc	-0.48 **	0.45 **	-0.03	0.61	2.23	0.03	1.30 **	nc	-0.44 **	0.41 **	-0.03	0.59	2.10	0.03	24
France[3]	0.97	..	..	..	..	NS	0.00	0.00	0.00	0.00	0.30	0.58	-0.04 **	0.32	2.07	0.02	0.37	0.46	-0.11	0.12	-0.04 *	0.26	2.43	0.02	0.38	0.41	-0.09	0.09	-0.04 *	0.29	2.14	0.02	22
Germany	0.77	0.77	-	-	0.34	[1]	0.00	0.00	0.00	0.00	0.77 **	0.03	0.01	0.34	2.19	0.07	0.82 **	0.38	-0.39	0.44	-0.02	0.47	2.43	0.07	0.58	0.14	-1.38 **	1.74 **	-0.21 *	0.51	1.93	0.06	17
Greece	1.16	1.16	-	-	0.35	[1]	0.00	0.00	0.00	0.00	1.16 **	nc	-0.02	0.35	1.93	0.03	1.20 **	nc	-0.48 **	0.45 **	-0.03	0.61	2.23	0.03	1.30 **	nc	-0.44 **	0.41 **	-0.03	0.59	2.10	0.03	24
Hungary	0.61	..	..	..	..	[1]	0.00	0.00	0.00	0.00	0.30	0.58	-0.04 **	0.32	2.07	0.02	0.37	0.46	-0.11	0.12	-0.04 *	0.26	2.43	0.02	0.38	0.41	-0.09	0.09	-0.04 *	0.29	2.14	0.02	22
Ireland[4]	1.18	1.19	1.03	1.18	0.81	[2]	-0.04	1.18	1.18	1.18	0.90 **	0.38	-0.14 **	0.82	1.95	0.04	1.19 **	0.46	-0.20	0.21	-0.09 *	0.81	1.88	0.04	0.84 *	0.67 *	-0.04	0.01	-0.12 *	0.83	2.00	0.04	22
Italy[3]	0.97	..	..	..	..	NS	0.00	0.00	0.00	0.00	0.30	0.58	-0.04 **	0.32	2.07	0.02	0.37	0.46	-0.11	0.12	-0.04 *	0.26	2.43	0.02	0.38	0.41	-0.09	0.09	-0.04 *	0.29	2.14	0.02	22
Luxembourg[3]	0.97	..	..	..	..	NS	0.00	0.00	0.00	0.00	0.30	0.58	-0.04 **	0.32	2.07	0.02	0.37	0.46	-0.11	0.12	-0.04 *	0.26	2.43	0.02	0.38	0.41	-0.09	0.09	-0.04 *	0.29	2.14	0.02	22
Netherlands	0.78	0.70	1.29	0.78	0.57	[2]	-0.14	0.78	0.85	0.78	0.53	0.04	-0.04 *	0.37	2.11	0.02	0.70 *	0.08	-0.14	0.18	-0.04 *	0.57	1.40	0.02	1.09 *	0.04	-0.63 *	0.72	-0.04 *	0.47	2.19	0.02	22
Poland	1.14	1.43	0.82	1.14	0.51	[2]	-0.60	1.06	0.92	1.14	0.58 *	nc	-0.06	0.27	2.04	0.05	1.43 *	nc	-0.60	0.49	-0.04	0.51	1.80	0.05	1.42 *	nc	-0.72	0.83	-0.03	0.22	2.07	0.05	17
Portugal	0.89	0.89	-	-	0.76	[1]	0.00	0.00	0.00	0.00	0.89 **	-0.41 *	-0.09 **	0.76	2.11	0.03	1.22 **	-0.33	-0.30	0.37	-0.08 **	0.76	2.24	0.03	1.06 *	-0.33	-0.13	0.16	-0.08 **	0.73	2.05	0.03	22
Slovak Republic	1.10	1.91	0.84	1.10	0.48	[3]	-1.47	0.34	1.07	1.10	0.47	-0.12	-0.07	0.16	2.08	0.05	1.23 *	-0.33	-0.70 **	0.56 **	-0.05	0.44	2.12	0.04	1.91 **	-0.57 *	-1.47 **	1.23 **	-0.03	0.48	2.08	0.04	17
Slovenia	0.63	0.69	0.43	0.63	0.86	[2]	-0.25	0.62	0.57	0.63	0.76 **	-0.07	-0.04 *	0.75	2.35	0.02	0.69 **	-0.21	-0.25	0.11	-0.03	0.86	2.02	0.02	0.65 *	-0.21	-0.18	0.05	-0.03	0.71	1.89	0.02	11
Spain	1.48	2.42	1.05	1.48	0.82	[3]	-1.06	0.97	1.06	1.48	0.88 *	0.01	-0.15 **	0.58	2.04	0.05	2.70 **	-0.12	-0.67 **	0.82 **	-0.09 *	0.76	1.58	0.04	2.42 **	-0.09	-1.06 **	1.12 **	-0.08 *	0.82	1.42	0.04	22
Sweden	1.19	1.85	0.72	1.19	0.53	[2]	-0.80	0.95	0.76	1.19	1.88 **	nc	0.04	0.36	2.01	0.05	1.85 **	nc	-0.80 **	0.58 **	0.05	0.53	1.97	0.04	2.11 **	nc	-0.44 *	0.54 *	0.05	0.50	1.94	0.04	24
United Kingdom	1.04	1.04	1.01	0.00	0.77	[2]	-1.00	1.01	1.01	1.02	0.12	-0.19 *	-0.09 *	0.52	2.12	0.03	1.04 *	0.07	-1.00 **	1.00 **	-0.07 *	0.77	1.82	0.02	1.07	0.05	-0.87 *	0.88 *	-0.07 *	0.74	2.17	0.02	22
European Union[5]	**0.97**	**..**	**..**	**..**	**0.58**		**-0.31**	**0.43**	**0.46**	**0.50**	**0.68**	**-0.06**	**-0.05**	**0.41**	**2.04**	**0.04**	**1.03**	**0.02**	**-0.42**	**0.44**	**-0.04**	**0.54**	**1.90**	**0.03**	**1.05**	**-0.04**	**-0.54**	**0.59**	**-0.05**	**0.50**	**1.99**	**0.03**	

Key: * Statistically significant at 10% level; ** Statistically significant at 5% level.

1. Constant, AR(1) and dummies not shown.
2. See Annex for methodology.
3. See Annex for methodology of model selection. Non statistically significant estimates (NS) are set to the EU average.
4.The second-best model (2) is preferred for Ireland.
5. Average calculated over coefficient estimates statistically significant.
Source: OECD calculations, OECD Economic Outlook 93, European Commission for EU7 non-OECD countries. VAT rates data are from Consumption Tax Trends 2012 (OECD) and VAT Rates Applied in the Member States of the European Union (European Commission).

Annex Table A1.5. Non-tax revenue to output gap elasticities[1]

Period 1990-2013

	e(ntax,y)	R^2 adjusted	Durbin Waston	Standard Error
Austria	0.48	-0.08	1.94	0.07
Belgium	-0.01	-0.08	1.98	0.06
Bulgaria	3.13	-1.53	1.31	0.53
Croatia	..	..	..	..
Cyprus	-1.21	-0.05	1.75	0.09
Czech Republic	-0.94	0.00	1.78	0.05
Denmark	-0.83	-0.01	1.73	0.06
Estonia	0.39	0.03	2.01	0.11
Finland	0.36	-0.05	2.16	0.07
France	-0.03	-0.08	2.02	0.05
Germany	0.16	-0.10	1.78	0.04
Greece	0.91	0.11	2.31	0.12
Hungary	-0.45	0.04	2.16	0.07
Ireland	-0.76	0.01	1.91	0.06
Italy	0.32	-0.09	1.76	0.05
Latvia	0.25	0.35	1.60	0.09
Lithuania	..	..	..	..
Luxembourg	1.63	0.18	1.85	0.07
Malta	..	..	..	..
Netherlands	0.81	-0.05	1.95	0.06
Poland	-1.17	-0.07	1.82	0.09
Portugal	1.55	-0.06	1.91	0.12
Romania	..	..	..	..
Slovak Republic	-2.12	0.19	2.06	0.16
Slovenia	0.33	-0.19	2.04	0.08
Spain	-1.65	-0.02	2.14	0.09
Sweden	0.42	-0.05	2.20	0.05
United Kingdom	0.38	-0.10	1.48	0.08
European Union[2]	**0.10**	**0.52**	**1.38**	**0.10**

Key: * Statistically significant at 10% level; ** Statistically significant at 5% level.

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

2. European Union is an average calculated over coefficient estimates statistically significant.

Source: OECD calculations, OECD Economic Outlook 93, EUROSTAT Cofog for EU28 for potential output, European Commission for EU7 non-OECD countries.

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 gap elasticity with respect to wages and salaries (WSSS), that 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.[25]

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 model also controls for any serial correlation in the residuals (ECT AR(1)). Though serial correlation does not affect the consistency of 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 0.6 to 1.1, which is similar to the range in the 2005 model, with an average of around 0.76; 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 ECT model 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 -0.05, indicates a rather slow 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 ECT model has been used

25. 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.

to estimate the elasticities for self-employment income and for the 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:

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

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 EU average and adjusted accordingly (Table A1.10), except in cases where the elasticities for self-employment are not statistically significant and where the hypothesis that the coefficient set to the EU average (1.55) can be statistically rejected, as for the Czech Republic.

21. The data used for the econometric analysis are mainly drawn from the *OECD Economic Outlook* and *OECD Analytical Databases*. Output gaps for all EU countries are drawn from Havik et al. (2014). Unemployment benefits time series for EU countries are mainly sourced from the COFOG and ESSPROS databases. Data for EU non-OECD countries are provided by the European Commission.

Annex Table A1.6. Wage and salaries to output gap regressions

Period 1990-2013

	Wage and salaries to output gap short-term elasticity[1]			Model AR(1), [1]				Model ECT, [2]						Model ECT+AR(1), [3]						N
	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	
Austria	0.70 **	0.64	[3]	0.39 **	0.53	1.75	0.01	0.64 *	0.02	0.60 *	0.12	0.40	0.02	0.70 **	0.09	0.54 *	0.64	1.98	0.01	22
Belgium	0.61 **	0.40	[2]	0.30	0.10	1.70	0.01	0.61 **	-0.01	0.79 **	0.40	1.36	0.01	0.64 **	0.01	0.71 **	0.39	1.93	0.01	22
Bulgaria	..	..	NA	0.59	-1.44	0.95	0.10	1.69 **	0.19	2.31 **	0.83	3.09	0.02	0.00	0.00	0.00	0.00	0.00	0.00	4
Croatia	..	..	NA	1.49 **	0.72	3.14	0.01	0.61 *	-0.04	0.70	0.96	3.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4
Cyprus[3]	0.91 *	0.43	[2]	0.59	0.00	1.47	0.02	0.91 *	-0.06 *	0.60	0.43	1.98	0.02	0.49	-0.09 *	0.25	0.23	1.70	0.02	13
Czech Republic	0.58 *	0.61	[2]	0.73 **	0.50	1.75	0.02	0.58 *	-0.15 **	0.35 *	0.61	1.39	0.02	0.72 **	-0.10 *	0.29	0.55	1.66	0.02	16
Denmark[3]	0.59 **	0.86	[3]	0.25	0.39	1.56	0.01	0.51 **	0.00	0.51 **	0.80	1.76	0.01	0.59 **	0.01	0.56 **	0.86	1.87	0.00	22
Estonia	1.44 **	0.94	[3]	0.86 **	0.56	1.16	0.05	1.07 **	-0.10 *	0.65 **	0.59	0.75	0.05	1.44 **	0.01	1.07 **	0.94	2.28	0.02	17
Finland	0.77 **	0.56	[3]	0.38 *	0.28	1.28	0.02	0.81 **	0.06	0.55 **	0.54	1.48	0.02	0.77 **	-0.01	0.80 **	0.56	1.50	0.02	22
France	0.64 **	0.79	[3]	0.49 **	0.59	1.63	0.01	0.66 **	-0.01	0.28 **	0.86	1.69	0.00	0.64 **	0.00	0.30 **	0.79	1.89	0.00	22
Germany	0.66 **	0.44	[3]	0.37 **	0.33	1.31	0.01	0.73 **	0.07	0.75 **	0.36	0.87	0.01	0.66 **	0.15	0.46 *	0.44	1.39	0.01	21
Greece	0.69 *	0.83	[2]	-0.04	0.64	2.46	0.04	0.69 *	-0.08 **	0.85 **	0.83	1.99	0.03	0.74 *	-0.09 **	0.84 **	0.82	2.07	0.03	22
Hungary	0.77 *	0.70	[2]	0.67 *	0.43	1.86	0.03	0.77 *	-0.11 **	0.18	0.70	1.97	0.03	0.77 *	-0.11 **	0.20	0.59	1.57	0.03	15
Ireland	1.08 **	0.66	[3]	0.62 *	0.42	1.77	0.03	1.19 **	-0.03	1.00 **	0.57	1.04	0.02	1.08 **	-0.07	1.07 **	0.66	1.85	0.02	22
Italy[4]	0.59 **	0.30	[3]	0.39 *	0.12	1.83	0.02	0.53 *	-0.01	0.58 **	0.33	1.63	0.02	0.59 **	0.01	0.52 **	0.30	2.04	0.01	22
Latvia	2.45 **	0.80	[2]	1.64 **	0.53	1.24	0.09	2.45 **	0.10	1.46 **	0.80	1.30	0.06	2.47 **	0.07	1.50 **	0.81	1.34	0.06	14
Lithuania	1.59 **	0.92	[3]	1.16 **	0.60	1.96	0.05	1.62 **	-0.03	0.97 **	0.91	2.99	0.02	1.59 **	-0.03	0.95 **	0.92	1.92	0.02	14
Luxembourg	0.44 **	0.36	[3]	0.21	0.22	1.44	0.01	0.41 **	0.02	0.36 *	0.25	1.08	0.01	0.44 **	0.02	0.43 *	0.36	1.53	0.01	22
Malta	0.97 **	0.71	[2]	0.07	0.05	2.09	0.02	0.97 **	-0.22 **	1.54 **	0.71	1.36	0.02	0.79 *	-0.19	1.36 *	0.40	1.88	0.02	10
Netherlands	0.73 **	0.76	[3]	0.27	0.39	1.37	0.01	0.79 **	0.03 *	0.91 **	0.72	1.11	0.01	0.73 **	0.02	0.91 **	0.76	1.84	0.01	22
Poland	1.24 **	0.93	[2]	0.82 *	0.69	2.14	0.03	1.24 **	-0.26 **	1.33 **	0.93	1.65	0.02	1.25 **	-0.23 **	1.31 **	0.88	2.10	0.02	17
Portugal	1.11 **	0.77	[2]	0.87 **	0.69	1.94	0.02	1.11 **	-0.09 **	0.81 **	0.77	1.00	0.02	1.16 **	-0.05	0.71 **	0.80	2.15	0.01	22
Romania	..	..	NA	3.33 *	0.34	2.20	0.13	3.24 *	-0.12	2.13	0.42	2.16	0.11	3.06	-0.18	1.80	0.33	2.41	0.13	8
Slovak Republic	0.75 **	0.65	[3]	0.67 **	0.38	2.03	0.02	0.71 **	-0.12 **	0.12	0.62	2.74	0.02	0.75 **	-0.13 **	0.15	0.65	2.25	0.02	15
Slovenia	0.61 **	0.95	[2]	0.52 **	0.73	1.21	0.02	0.61 **	-0.20 **	0.60 **	0.95	1.85	0.01	0.67 **	-0.17 **	0.59 **	0.94	1.82	0.01	12
Spain	0.88 **	0.87	[2]	0.91 **	0.67	1.91	0.02	0.88 **	-0.08 **	0.64 **	0.87	1.68	0.01	0.93 **	-0.07 **	0.62 **	0.84	2.00	0.01	22
Sweden	0.75 **	0.30	[3]	0.49 *	0.17	1.66	0.02	0.75 **	-0.05	0.65 **	0.35	1.99	0.02	0.75 **	-0.03	0.56 *	0.30	1.70	0.02	22
United Kingdom	0.48 **	0.66	[3]	0.19	0.15	1.22	0.01	0.20	0.00	0.30 *	0.12	1.24	0.01	0.48 **	0.06 *	0.43 **	0.66	1.53	0.01	22
European Union[5]	**0.88**	**0.67**		**0.69**	**0.35**	**1.72**	**0.03**	**0.96**	**-0.05**	**0.80**	**0.62**	**1.68**	**0.02**	**0.89**	**-0.04**	**0.68**	**0.59**	**1.72**	**0.02**	

Key: * Statistically significant at 10% level; ** Statistically significant at 5% level.

1. Constant, AR(1) and dummies not shown.
2. See Annex for methodology of model selection. NA is applied where there are missing data and too few observation. NS when estimates are not statistically significant.
3. Dummy control in 2003 for Cyprus ; 2000 for Denmark.
4. The second-best model (3) is preferred for Italy.
5. Average calculated over coefficient estimates statistically significant.

Source: OECD calculations, OECD Economic Outlook 93, EUROSTAT Cofog for EU28 for potential output, European Commission for EU7 non-OECD countries.

Annex Table A1.7. Self employment to output gap regressions

Period 1990-2013

	Self-employed income to output short-term elasticity[1]			Model AR(1), [1]				Model ECT, [2]						Model ECT+AR(1), [3]						N
	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	
Austria	0.91 **	0.58	[2]	1.37 **	0.44	1.77	0.02	0.91 **	-0.04	-0.93 *	0.58	1.82	0.02	0.90 *	-0.04	-0.94 *	0.55	1.87	0.02	22
Belgium	1.11 **	0.39	[2]	0.99 *	0.20	1.94	0.02	1.11 **	-0.28 **	0.24	0.39	1.90	0.02	1.26 **	-0.80	1.25	0.51	2.35	0.02	22
Bulgaria	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4
Croatia	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4
Cyprus	..	..	NS	0.92 *	0.13	1.42	0.02	0.29	-0.22	-0.63	0.26	1.38	0.02	0.72	-0.63	-0.32	0.30	1.64	0.02	13
Czech Republic	..	..	NS	-0.50	0.12	2.09	0.03	-0.13	-0.32 *	-0.06	0.29	1.47	0.03	-0.20	-0.58	-0.06	0.33	1.90	0.03	16
Denmark	..	..	NS	0.37	0.03	1.88	0.07	0.30	-0.14	-1.48 **	0.34	1.92	0.06	0.30	-0.14	-1.46 **	0.29	1.94	0.06	22
Estonia	1.22 *	0.58	[2]	1.45 **	0.51	1.41	0.07	1.22 *	-0.46 **	0.49	0.58	1.02	0.10	1.49 **	0.05	-0.02	0.43	1.48	0.08	17
Finland	..	..	NS	0.06	0.14	1.96	0.03	0.25	-0.10	0.02	0.01	2.80	0.04	0.04	-0.06	-0.04	0.16	1.99	0.03	22
France	1.59 **	0.57	[3]	1.45 **	0.52	1.67	0.02	1.38 **	-0.06	0.38 *	0.55	1.40	0.02	1.59 **	-0.10	0.60	0.57	1.62	0.02	22
Germany	1.79 **	0.55	[3]	1.74 **	0.52	2.20	0.03	1.73 **	-0.16	0.93 *	0.38	1.01	0.03	1.79 **	-0.33	0.68	0.55	2.06	0.03	21
Greece	..	..	NS	0.72	0.19	1.64	0.05	0.61	-0.20 *	0.81 **	0.58	1.95	0.04	0.65	-0.19	0.79 **	0.50	1.79	0.04	17
Hungary	1.17 *	0.18	[1]	1.17 *	0.18	1.88	0.05	0.84 *	-0.22 *	-0.09	0.45	2.31	0.04	0.79	-0.29 **	-0.16	0.51	2.26	0.04	15
Ireland	1.68 *	0.40	[2]	1.63 *	0.13	1.97	0.07	1.68 *	-0.52 *	1.75 **	0.40	1.92	0.06	1.30	-0.89 *	2.52 *	0.41	1.69	0.06	22
Italy	0.82 **	0.32	[3]	0.83 *	0.21	2.14	0.02	0.80 *	-0.09 **	0.35	0.41	2.14	0.02	0.82 **	-0.07 *	0.28	0.32	2.10	0.02	22
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
Lithuania	1.28 *	0.35	[3]	1.23 **	0.37	1.75	0.08	1.29 **	-0.12	0.26	0.36	1.48	0.08	1.28 *	-0.69	1.25	0.35	1.88	0.08	14
Luxembourg	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6
Malta	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Netherlands	5.35 **	0.72	[3]	4.92 **	0.62	1.97	0.06	5.48 **	-0.30 *	2.34 **	0.71	1.89	0.05	5.35 **	-0.84 *	5.71 **	0.72	1.73	0.05	22
Poland	0.72 *	0.69	[3]	0.49	0.02	2.33	0.04	0.68	-0.22 **	0.51 *	0.70	3.03	0.03	0.72 *	-0.20 **	0.47 **	0.69	2.03	0.03	17
Portugal	..	..	NS	-1.04	-0.07	2.05	0.11	-1.45	-0.39 *	1.49 *	0.19	2.29	0.10	-2.02	-0.34 *	1.36 *	0.18	2.00	0.10	22
Romania	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Slovak Republic	1.06 **	0.65	[2]	0.96 **	0.53	1.63	0.04	1.06 **	-0.13 **	0.24	0.65	1.53	0.03	1.20 **	-0.20 **	0.60 *	0.85	2.10	0.02	15
Slovenia	1.21 **	0.43	[1]	1.21 **	0.43	1.97	0.05	1.38 **	-0.47 **	1.18 **	0.81	3.02	0.03	1.44 **	-0.53 **	1.26 **	0.95	2.36	0.01	12
Spain	1.18 *	0.43	[2]	0.96	0.15	1.34	0.05	1.18 *	-0.12 *	0.86 **	0.43	1.62	0.04	1.10	-0.14 *	0.94 *	0.40	1.65	0.04	22
Sweden	1.07 *	0.53	[2]	1.05 *	0.17	2.32	0.05	1.07 *	-0.49 **	0.37	0.53	1.80	0.04	1.08 *	-0.75	0.92	0.46	1.96	0.04	22
United Kingdom	2.66 *	0.22	[1]	2.66 *	0.22	2.05	0.07	1.87	-0.18 *	-0.91	0.34	2.36	0.07	1.37	-0.14 *	-0.99	0.35	2.07	0.07	22
European Union[3]	**1.55**	**0.48**		**0.90**	**0.21**	**1.56**	**0.04**	**0.86**	**-0.19**	**0.27**	**0.35**	**1.58**	**0.04**	**0.84**	**-0.29**	**0.51**	**0.37**	**1.60**	**0.04**	

Key: * Statistically significant at 10% level; ** Statistically significant at 5% level.

1. Constant, AR(1) and dummies not shown.
2. See Annex for methodology of model selection. NA is applied where there are missing data and too few observation. NS when estimates are not statistically significant.
3. Average calculated over coefficient estimates statistically significant.
Source: OECD calculations, OECD Economic Outlook 93, EUROSTAT Cofog for EU28 for potential output, European Commission for EU7 non-OECD countries.

Annex Table A1.8. Gross operating surplus to output gap regressions

Period 1990-2013

	Gross operating surplus to output short-term elasticity[1]			Model AR(1), [1]				Model ECT, [2]						Model ECT+AR(1), [3]						N
	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	
Austria	1.55 **	0.71	[1]	1.55 **	0.71	1.69	0.01	1.29 **	-0.03	-0.32	0.71	1.36	0.01	1.32 **	-0.04	-0.44	0.73	1.65	0.01	22
Belgium	1.68 **	0.53	[1]	1.68 **	0.53	1.85	0.02	1.41 **	-0.01	-0.54	0.55	1.95	0.02	1.44 **	-0.02	-0.44	0.52	1.86	0.02	22
Bulgaria	..	..	NA	2.87 **	0.87	2.14	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4
Croatia	..	..	NA	0.71	-0.73	2.50	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4
Cyprus	3.10	0.81	[1]	3.10 **	0.81	1.73	0.02	3.01 **	0.06	-0.39	0.81	2.07	0.02	3.18 **	0.05	-0.33	0.80	2.16	0.02	13
Czech Republic	0.96 **	0.81	[3]	0.75	0.11	1.76	0.04	1.00 **	-0.24 **	0.71 *	0.60	2.88	0.03	0.96 **	-0.29 **	0.86 **	0.81	1.89	0.02	16
Denmark	1.83 **	0.81	[1]	1.83 **	0.81	2.11	0.02	2.23 **	0.01	-0.24	0.71	2.87	0.03	1.82 **	0.02	-0.22 *	0.83	2.21	0.02	22
Estonia	1.37 **	0.86	[2]	1.52 **	0.83	2.32	0.04	1.37 **	-0.11 **	-0.04	0.86	1.94	0.04	1.49 **	-0.09 **	0.05	0.87	2.35	0.03	17
Finland	1.71 **	0.79	[2]	1.84 **	0.69	1.36	0.03	1.71 **	-0.06	-0.39	0.79	1.45	0.03	1.71 **	-0.16 *	0.15	0.77	1.59	0.03	22
France	1.49 **	0.69	[2]	1.54 **	0.70	1.93	0.01	1.49 **	-0.02	0.21	0.69	1.72	0.01	1.56 **	-0.02	0.17	0.68	1.90	0.01	22
Germany	1.14 **	0.70	[2]	1.36 **	0.56	1.85	0.02	1.14 **	-0.11 **	-0.38	0.70	1.77	0.02	1.14 **	-0.12 **	-0.37	0.68	1.88	0.02	21
Greece	1.26 **	0.43	[3]	1.04 **	0.33	1.78	0.03	1.33 **	-0.04	-0.38 *	0.42	2.47	0.03	1.26 **	-0.02	-0.32 *	0.43	2.04	0.03	17
Hungary	1.28 **	0.55	[1]	1.28 **	0.55	1.96	0.03	0.92 **	-0.11 **	-0.17	0.75	2.17	0.02	0.81 *	-0.09 **	-0.08	0.67	2.19	0.02	15
Ireland	1.97 **	0.40	[2]	1.68 **	0.42	2.11	0.05	1.97 **	-0.06	0.04	0.40	1.36	0.05	1.54 *	-0.09	-0.11	0.44	2.16	0.05	22
Italy	1.44 **	0.81	[3]	1.45 **	0.57	2.45	0.02	1.38 **	-0.09 **	-0.15	0.79	2.74	0.02	1.44 **	-0.10 **	-0.16	0.81	2.21	0.02	22
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
Lithuania	1.51 **	0.63	[3]	1.48 **	0.51	1.90	0.07	1.20 **	-0.07	-0.30	0.47	1.66	0.07	1.51 **	-0.86 **	0.69	0.63	2.05	0.06	14
Luxembourg	..	..	NA	3.03	0.75	1.86	0.05	0.00	0.00	0.00	0.00	0.00	0.00	2.36 **	-0.10 *	-1.09 **	0.96	3.63	0.02	6
Malta	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Netherlands	1.11 **	0.42	[3]	1.35 **	0.40	1.90	0.02	1.10 **	-0.04	-0.39	0.46	1.94	0.02	1.11 **	-0.04	-0.39	0.42	1.86	0.02	22
Poland	1.59 **	0.67	[3]	1.87 **	0.38	2.46	0.04	1.67 **	-0.11 **	0.14	0.73	2.63	0.03	1.59 **	-0.11 **	0.15	0.67	1.88	0.03	17
Portugal	1.73 *	0.31	[2]	1.78	0.05	1.93	0.08	1.73 *	-0.14 **	-0.95	0.31	1.95	0.07	1.77 *	-0.16 **	-0.78	0.33	2.06	0.07	22
Romania	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Slovak Republic	1.48 **	0.77	[3]	1.62 **	0.60	1.86	0.04	1.41 **	-0.14 **	-0.27	0.78	2.24	0.03	1.48 **	-0.17 **	-0.16	0.77	1.93	0.03	15
Slovenia	1.27 **	0.87	[2]	1.34 **	0.81	2.09	0.03	1.27 **	-0.19 **	0.20	0.87	1.82	0.02	1.25 **	-0.21 *	0.25	0.84	1.81	0.02	12
Spain	1.43 **	0.54	[2]	1.70 **	0.49	1.65	0.02	1.43 **	-0.02	-0.30 *	0.54	1.56	0.02	1.54 **	-0.02	-0.33 *	0.53	1.76	0.02	22
Sweden	1.15 **	0.55	[3]	1.43 **	0.48	1.96	0.03	1.24 **	-0.12 **	-0.10	0.49	2.02	0.03	1.15 **	-0.06	-0.45	0.55	1.80	0.03	22
United Kingdom	1.31 **	0.49	[1]	1.31 **	0.49	1.86	0.02	1.08	-0.05	-0.16	0.44	1.51	0.02	1.18 **	-0.04	-0.16	0.46	1.76	0.02	22
European Union[3]	**1.50**	**0.64**		**1.51**	**0.48**	**1.82**	**0.03**	**1.19**	**-0.06**	**-0.15**	**0.51**	**1.61**	**0.02**	**1.27**	**-0.10**	**-0.12**	**0.56**	**1.73**	**0.02**	

Key: * Statistically significant at 10% level; ** Statistically significant at 5% level.

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

Source: OECD calculations, OECD Economic Outlook 93, EUROSTAT Cofog for EU28 for potential output, European Commission for EU7 non-OECD countries.

Annex Table A1.9. Capital income to output gap regressions

Period 1990-2013

	Capital income to output short-term elasticity[1]			Model AR(1), [1]				Model ECT, [2]						Model ECT+AR(1), [3]						N
	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	
Austria	3.75 *	0.48	[3]	2.99 *	0.12	1.64	0.11	4.65 **	-0.31 *	4.51 *	0.31	1.37	0.09	3.75 *	-0.59	5.81 **	0.48	1.49	0.08	22
Belgium	3.99 **	0.57	[2]	1.10	-0.06	1.98	0.08	3.99 **	-0.15	3.68 **	0.57	1.65	0.05	1.79	-0.75 *	3.69 *	0.21	1.93	0.07	21
Bulgaria	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Croatia	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Cyprus[3]	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Czech Republic	2.21 **	0.78	[3]	1.45	0.07	1.82	0.06	0.05	-0.59 *	0.92	0.16	0.71	0.10	2.21 **	-0.35	2.14 **	0.78	1.76	0.03	15
Denmark	1.50 *	0.54	[2]	1.76	0.03	1.99	0.09	1.50 *	-0.28 *	1.95 **	0.54	1.94	0.06	1.00	-1.08 **	4.04 **	0.48	1.94	0.07	22
Estonia	4.17 *	0.56	[3]	6.05 **	0.35	1.03	0.40	5.99 **	-0.25 *	3.40 *	0.46	1.99	0.36	4.17 *	-0.29 **	2.58 *	0.56	1.49	0.33	16
Finland	3.34 **	0.51	[2]	3.06 *	0.26	1.96	0.12	3.34 **	-0.13	2.96 **	0.51	1.97	0.10	3.75 **	-0.13	2.84 **	0.51	2.01	0.10	21
France	4.02 **	0.63	[2]	1.80	0.08	1.99	0.06	4.02 **	0.12	1.27 **	0.63	2.06	0.04	1.86	-0.11	1.32 *	0.22	2.01	0.05	22
Germany	1.32 *	0.31	[3]	1.16 **	0.28	1.97	0.03	1.22 *	-0.10	0.11	0.30	2.51	0.03	1.32 *	-0.09	0.13	0.31	2.00	0.03	20
Greece	3.75 *	0.68	[3]	3.56	0.08	1.82	0.16	5.73 *	-0.16	-1.14	0.25	2.03	0.14	3.75 *	-0.10	-1.67	0.68	1.83	0.09	16
Hungary	..	..	NS	-0.42	-0.06	2.12	0.11	-1.63	-0.36 *	0.97	0.31	2.35	0.08	-1.14	-0.25 *	1.05	0.25	2.03	0.09	14
Ireland	3.05 *	0.74	[3]	6.40 **	0.38	2.07	0.17	6.38 **	-0.45 *	5.90 **	0.45	2.01	0.15	3.05 *	-0.17	2.48 *	0.74	1.89	0.11	21
Italy	3.28 **	0.75	[3]	2.95 **	0.55	1.88	0.05	3.22 **	-0.40 **	2.14 **	0.67	1.06	0.04	3.28 **	-0.62 *	3.54 **	0.75	1.34	0.03	22
Latvia	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Lithuania	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Luxembourg	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5
Malta	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Netherlands	4.86 **	0.82	[3]	4.58 **	0.50	2.06	0.07	5.41 **	-0.24 *	2.49 *	0.57	1.48	0.06	4.86 **	-0.23 *	2.27 **	0.82	2.02	0.82	22
Poland	..	..	NS	0.66	-0.14	1.64	0.14	-1.78	-0.46	0.98	0.25	2.38	0.11	-3.76	-0.73 *	-0.08	0.39	1.89	0.11	16
Portugal	4.37 *	0.81	[2]	4.93	-0.06	2.00	0.39	4.37 *	-0.07	-0.87	0.81	1.80	0.16	6.37	-0.32 **	-4.98 *	0.24	2.10	0.33	22
Romania	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Slovak Republic	4.26 **	0.57	[3]	1.64	-0.06	1.86	0.17	3.47 *	0.03	3.28 *	0.32	2.99	0.13	4.26 **	0.19	3.69 **	0.57	2.42	0.11	14
Slovenia	3.71 *	0.61	[3]	4.00 *	0.41	2.02	0.15	2.57 *	-0.83 *	2.92 *	0.57	1.35	0.12	3.71 *	-0.88 *	5.34 *	0.61	1.40	0.12	12
Spain	4.55 *	0.82	[3]	3.28	-0.03	2.00	0.22	3.50	-0.36 *	0.20	0.17	2.04	0.19	4.55 *	-0.33	1.12	0.82	1.69	0.09	22
Sweden	2.66 *	0.29	[3]	2.07	0.02	1.97	0.14	4.19 *	-0.01	4.16 *	0.26	1.84	0.12	2.66 *	-0.76 **	5.33 **	0.29	1.99	0.12	22
United Kingdom	4.21 **	0.66	[2]	5.02 **	0.56	2.01	0.07	4.21 **	-0.51 *	3.40 **	0.66	1.51	0.06	4.95 **	-0.70	4.54	0.73	2.06	0.05	22
European Union[3]	**3.50**	**0.62**		**2.00**	**0.11**	**1.30**	**0.10**	**2.22**	**-0.19**	**1.49**	**0.30**	**1.28**	**0.08**	**1.94**	**-0.29**	**1.56**	**0.36**	**1.29**	**0.10**	

Key: * Statistically significant at 10% level; ** Statistically significant at 5% level.

1. Constant, AR(1) and dummies not shown. The data source for capital income, based on OECD ADB database, is subject to frequent national revisions.

2. NA for missing data and too few observations for the regression. NS for estimates which are not statistically significantly. See Annex for methodology of model regressions.

3. Average calculated over coefficient estimates statistically significant.

Source: OECD calculations, OECD Analytical Data Base, EUROSTAT Cofog for EU28 for potential output, European Commission for EU7 non-OECD countries.

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

Period 1990-2013

	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
Austria	0.85	0.70	1.44	1.00	0.91 **	0.70 **	1.55 **	0.11	0.51	0.38
Belgium	1.01	0.61	1.53	1.00	1.11 **	0.61 **	1.68 **	0.10	0.52	0.38
Bulgaria	1.23	0.66	1.18	1.00	1.55 NA	0.82 NA	1.48 NA	0.11	0.35	0.54
Croatia	1.33	0.71	1.27	1.00	1.55 NA	0.82 NA	1.48 NA	0.07	0.48	0.44
Cyprus	0.58	0.91	1.17	1.00	1.55 NS	0.91 *	3.10 **	0.09	0.45	0.46
Czech Republic[3]	0.00	0.87	1.45	1.00	0.00 NS	0.58 *	0.96 **	0.14	0.42	0.44
Denmark	1.28	0.59	1.52	1.00	1.55 NS	0.59 **	1.83 **	0.05	0.54	0.40
Estonia	0.88	1.03	0.99	1.00	1.22 *	1.44 **	1.37 **	0.07	0.47	0.46
Finland	1.13	0.77	1.25	1.00	1.55 NS	0.77 **	1.71 **	0.07	0.50	0.42
France	1.45	0.66	1.36	1.00	1.59 **	0.66 **	1.49 **	0.12	0.53	0.35
Germany	1.90	0.70	1.20	1.00	1.79 **	0.66 **	1.14 **	0.09	0.53	0.38
Greece	1.29	0.69	1.05	1.00	1.55 NS	0.69 *	1.26 **	0.27	0.31	0.42
Hungary	1.11	0.77	1.22	1.00	1.17 *	0.77 *	1.28 **	0.12	0.46	0.42
Ireland	1.07	0.69	1.26	1.00	1.68 *	1.08 **	1.97 **	0.10	0.42	0.48
Italy	0.84	0.60	1.47	1.00	0.82 **	0.59 **	1.44 **	0.17	0.42	0.41
Latvia[4]	1.52	0.81	1.05	1.00	1.55 NS	0.82 **	1.08 **	0.12	0.43	0.45
Lithuania	0.84	1.04	0.99	1.00	1.28 *	1.59 **	1.51 **	0.09	0.41	0.50
Luxembourg	1.37	0.44	1.30	1.00	1.55 NA	0.44 **	1.48 NA	0.08	0.36	0.56
Malta	1.22	0.76	1.17	1.00	1.55 NA	0.97 **	1.48 NA	0.15	0.43	0.42
Netherlands	2.20	0.73	1.11	1.00	5.35 **	0.73 **	1.11 **	0.07	0.51	0.42
Poland	0.58	0.99	1.27	1.00	0.72 *	1.24 **	1.59 **	0.25	0.34	0.40
Portugal	1.11	0.79	1.24	1.00	1.55 NS	1.11 **	1.73 *	0.11	0.51	0.38
Romania	1.17	0.62	1.11	1.00	1.55 NA	0.82 NA	1.48 NA	0.19	0.25	0.56
Slovak Republic	0.92	0.75	1.28	1.00	1.06 **	0.75 **	1.48 **	0.20	0.39	0.41
Slovenia	1.32	0.66	1.38	1.00	1.21 **	0.61 **	1.27 **	0.12	0.52	0.37
Spain	0.98	0.88	1.18	1.00	1.18 *	0.88 **	1.43 **	0.16	0.49	0.35
Sweden	1.22	0.75	1.30	1.00	1.07 *	0.75 **	1.15 **	0.05	0.54	0.41
United Kingdom	2.74	0.50	1.35	1.00	2.66	0.48	1.31	0.08	0.54	0.38
European Union	**1.22**	**0.74**	**1.25**		**1.55**	**0.82**	**1.48**	**0.12**	**0.45**	**0.43**

Key: * Statistically significant at 10% level; ** Statistically significant at 5% level.

1. Adjusted elasticities are based on freely estimated elasticities weighted by GDP components. Detailed methodology is described in the Annex.
2. Elasticity estimates for countries with NA or NS specification, are set to the EU average. NA is applied where there are missing data and too few observations for the regression. NS denotes not statistically significant estimates. European Union average is calculated over statistically significant estimates.
3. Self-employment income to output elasticity is set to zero, since cointegration tests reject the assumption of an elasticity equal to the EU average.
4. Wage/output elasticity is set to the EU average given the small sample (14 observations).

Source: OECD calculations, OECD Economic Outlook 93, EUROSTAT Cofog for EU28 for potential output, European Commission for EU7 non-OECD countries.

Annex Table A1.11. Unemployment to output gap regressions

Period 1990-2013

	Unemployment to output gap short-term elasticity[1]			Model AR(1) , [1]				Model ECT, [2]						Model ECT+AR(1) , [3]						N
	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	
Austria	-4.71 **	0.53	[2]	-4.76 **	0.42	1.96	0.08	-4.71 **	-0.42 *	-2.77 *	0.53	1.80	0.07	-5.05 **	-0.50	-3.49	0.53	2.08	0.07	22
Belgium	-3.70 **	0.60	[2]	-2.70 *	0.27	1.75	0.07	-3.70 **	-0.43 **	-4.51 **	0.60	1.14	0.05	-3.77 **	-0.74 **	-6.49 **	0.72	1.35	0.05	22
Bulgaria	..	..	NS	-1.10	-0.17	1.95	0.10	0.77	-1.19 **	-1.60 *	0.58	1.69	0.06	-1.00	-1.07 **	-3.65 *	0.48	1.30	0.07	10
Croatia	-2.39 **	0.96	[2]	-0.80	0.54	1.13	0.09	-2.39 **	-0.41 **	-4.28 **	0.96	1.96	0.03	-2.44 **	-0.39 **	-4.29 **	0.95	2.04	0.03	10
Cyprus	-3.08 **	0.57	[3]	-3.90	0.13	1.65	0.15	-3.56 *	-0.42 *	-7.67 **	0.58	2.36	0.10	-3.08	-0.43 *	-8.82 **	0.57	1.99	0.10	14
Czech Republic	-2.45 *	0.58	[3]	-2.45	0.24	1.17	0.10	-0.68	-0.61 *	-2.20 *	0.48	1.24	0.08	-2.45 *	-0.59 *	-3.97 *	0.58	1.03	0.08	16
Denmark	-4.97 **	0.77	[2]	-6.48 **	0.58	1.91	0.11	-4.97 **	-0.59 **	-5.65 **	0.77	1.52	0.08	-5.59 **	-0.77 *	-7.13 *	0.76	2.01	0.08	22
Estonia	-5.18 **	0.93	[2]	-4.38 **	0.78	1.49	0.13	-5.18 **	-0.11	-2.38 *	0.93	1.46	0.07	-4.73 **	-0.47	-3.97 **	0.93	1.73	0.08	12
Finland	-3.66 **	0.86	[2]	-2.30 **	0.73	2.09	0.06	-3.66 **	-0.63 **	-4.09 **	0.86	0.70	0.05	-3.01 **	-0.56 **	-3.48 **	0.90	2.44	0.04	22
France	-3.23 **	0.68	[3]	-3.87 **	0.44	1.76	0.06	-2.98 **	-0.53 **	-3.14 **	0.66	1.50	0.04	-3.23 **	-0.74 *	-4.34 **	0.68	1.78	0.04	22
Germany	-3.30 **	0.77	[3]	-2.20 **	0.55	1.66	0.06	-3.05 **	-0.32 *	-1.59	0.47	0.74	0.06	-3.30 **	-0.43	-3.79 **	0.77	1.58	0.04	21
Greece	-3.15 **	0.59	[3]	-3.55 **	0.56	1.84	0.07	-3.98 **	0.05	-0.56	0.48	1.34	0.07	-3.15 **	-0.59 *	-3.05	0.59	2.00	0.07	22
Hungary	-1.25 *	0.24	[2]	-1.11	0.05	1.88	0.06	-1.25 *	-0.45 *	-0.94 *	0.24	1.52	0.05	-1.19 *	-0.80	-1.71	0.25	1.69	0.05	15
Ireland	-5.45 **	0.53	[2]	-4.69 **	0.46	1.97	0.11	-5.45 **	-0.19	-2.30 *	0.53	1.56	0.10	-4.57 **	-0.51	-3.57	0.54	1.93	0.10	22
Italy	-2.29 **	0.60	[2]	-1.32 *	0.45	1.75	0.04	-2.29 **	-0.05	-2.03 **	0.60	1.56	0.04	-1.96 **	-0.12	-1.71 **	0.59	1.90	0.03	22
Latvia	-3.94 **	0.94	[2]	-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
Lithuania	-5.60 **	0.84	[3]	-5.39 **	0.64	1.49	0.18	-5.08 **	-0.81 **	-6.18 **	0.70	0.91	0.18	-5.60 **	-0.57 *	-5.36 **	0.84	2.09	0.12	15
Luxembourg	-3.06 **	0.69	[2]	-1.72 *	0.28	2.04	0.11	-3.06 **	-0.45 **	-3.90 **	0.69	1.56	0.07	-2.44 **	-0.72 **	-4.77 **	0.76	2.13	0.06	22
Malta	-1.96 **	0.73	[3]	-1.93 *	0.39	1.73	0.05	-1.81 *	-0.77 **	-1.25	0.62	2.43	0.04	-1.96 **	-1.14	-2.35	0.73	1.87	0.03	17
Netherlands	-5.76 **	0.82	[3]	-4.34 **	0.46	1.65	0.11	-6.96 **	-0.24 *	-5.65 **	0.63	0.96	0.09	-5.76 **	-0.59 **	-9.21 **	0.82	2.05	0.06	22
Poland	-6.18 **	0.68	[3]	-6.70 **	0.52	1.83	0.12	-7.77 **	-0.64 *	-6.29 *	0.66	1.38	0.10	-6.18 **	-0.81	-7.90 *	0.68	1.49	0.09	17
Portugal	-6.04 **	0.74	[3]	-5.98 **	0.54	1.92	0.10	-6.63 **	-0.26 *	-3.57 **	0.67	1.42	0.08	-6.04 **	-0.79 **	-8.70 **	0.74	2.41	0.07	22
Romania	..	..	NS	-0.78 *	0.59	1.78	0.05	-0.32	-1.60 **	-0.53	0.77	1.82	0.04	-0.29	-1.33	-0.50	0.68	1.68	0.04	10
Slovak Republic	-2.98 **	0.89	[2]	-3.95 **	0.56	2.08	0.09	-2.98 **	-0.92 **	-4.94 **	0.89	1.58	0.04	-2.88 **	-1.07 **	-5.48 **	0.89	1.20	0.04	15
Slovenia	-2.81 **	0.86	[3]	-2.53 **	0.55	1.60	0.08	-2.95 **	-0.52 *	-2.66 *	0.67	0.89	0.07	-2.81 **	-0.78 **	-3.88 **	0.86	2.10	0.05	12
Spain	-5.83 **	0.78	[3]	-6.68 **	0.76	1.97	0.06	-6.26 **	-0.17	-1.25	0.75	1.38	0.06	-5.83 **	-0.49	-2.86	0.78	1.85	0.06	22
Sweden	-4.42 **	0.82	[3]	-2.75 **	0.60	1.65	0.10	-5.14 **	-0.45 **	-6.06 **	0.65	0.52	0.10	-4.42 **	-0.38	-5.33 **	0.82	1.69	0.07	22
United Kingdom	-4.21 **	0.73	[3]	-3.50 **	0.60	1.97	0.05	-4.48	-0.27 *	-2.74 **	0.71	0.86	0.05	-4.21 **	-0.35	-3.18 *	0.73	1.99	0.04	22
European Union[3]	**-3.91**	**0.72**		**-3.43**	**0.48**	**1.76**	**0.09**	**-3.73**	**-0.50**	**-3.34**	**0.66**	**1.42**	**0.07**	**-3.61**	**-0.65**	**-4.48**	**0.72**	**1.82**	**0.06**	

Key: * Statistically significant at 10% level; ** Statistically significant at 5% level.

1. Constant, AR(1) and dummies not shown.
2. See Annex for methodology of model regressions. NA for missing data and too few observations for the regression. NS for estimates which are not statistically significantly.
3. Average calculated over coefficient estimates statistically significant.
Source: OECD calculations, OECD Economic Outlook 93, EUROSTAT Cofog for EU28 for potential output, European Commission for EU7 non-OECD countries.

Annex Table A1.12. Unemployment benefits to unemployment rate regressions

Period 1990-2013

	Unemployment benefits to unemployment rate elasticity[1]			Model AR(1), [1]				Model ECT, [2]						Model ECT+AR(1), [3]						N
	e(uben,unr)	R^2 adj.	Model[2]	dln(unr)	R^2 adj.	DW	SE	dln(unr)	ln(uben $_{t-1}$)	ln(unr$_{t-1}$)	R^2 adj.	DW	SE	dln(unr)	ln(uben $_{t-1}$)	ln(unr $_{t-1}$)	R^2 adj.	DW	SE	
Austria	0.52 **	0.30	[2]	0.47 *	0.25	2.06	0.08	0.52 **	-0.14	0.16	0.30	1.82	0.08	0.54 *	-0.11	0.21	0.20	1.98	0.08	21
Belgium	0.26 **	0.61	[3]	0.30 **	0.43	1.62	0.03	0.24 **	0.02	-0.13 *	0.56	2.67	0.03	0.26 **	0.04 *	-0.11 *	0.61	1.60	0.03	20
Bulgaria	..	..	NS	-0.79	0.20	2.30	0.63	-0.88	-0.65 *	0.35	0.20	2.27	0.61	-0.90	-0.40	0.26	0.24	2.17	0.61	13
Croatia	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3
Cyprus	0.31 **	0.68	[3]	0.31 **	0.51	1.71	0.05	0.28 **	-0.08	0.22 **	0.63	2.67	0.04	0.31 **	-0.07 *	0.17 **	0.68	2.11	0.04	16
Czech Republic	0.68 **	0.61	[3]	0.85 **	0.42	1.73	0.14	0.53 *	-0.15	-0.05	0.38	1.27	0.14	0.68 **	-0.61 *	-0.04	0.61	1.73	0.12	16
Denmark	0.33 **	0.78	[3]	0.31 **	0.61	2.06	0.05	0.40 **	-0.19 *	0.17 **	0.77	1.82	0.04	0.33 **	-0.83 **	0.45 **	0.78	1.71	0.04	21
Estonia	0.55 **	0.60	[1]	0.55 **	0.60	1.96	0.15	0.69 **	-0.03	0.27 *	0.79	2.78	0.10	0.72 **	0.10	0.22 *	0.84	2.46	0.10	11
Finland	0.61 **	0.91	[2]	0.77 **	0.81	1.91	0.06	0.61 **	-0.19 *	0.03	0.91	1.97	0.05	0.57 **	-0.34 *	0.03	0.88	1.85	0.05	21
France	0.49 *	0.52	[3]	0.70 **	0.39	1.78	0.07	0.35 *	-0.18 *	-0.41 **	0.45	1.19	0.06	0.49 *	-0.25	-0.35	0.52	1.96	0.06	21
Germany	0.60 **	0.39	[1]	0.60 **	0.39	2.01	0.08	0.36	-0.25 *	-0.11	0.58	1.11	0.10	0.54 *	-0.07	0.02	0.33	1.97	0.09	21
Greece	..	..	NS	0.33	0.07	1.97	0.19	0.53	-0.11	-0.09	0.07	2.49	0.19	0.42	-0.07	-0.04	0.04	1.96	0.19	21
Hungary	..	..	NS	0.24	-0.05	1.48	0.15	0.64	-0.18	-0.05	0.11	1.58	0.13	0.76	-0.25	0.05	0.04	1.69	0.14	16
Ireland	0.55 **	0.82	[3]	0.51 **	0.80	1.73	0.06	0.57 **	-0.08 **	0.01	0.81	1.33	0.05	0.55 **	-0.10 *	0.02	0.82	1.83	0.05	21
Italy	0.71 **	0.58	[2]	0.73 **	0.35	1.97	0.09	0.71 **	-0.17 *	-0.37 **	0.58	2.00	0.07	0.71 **	-0.14 *	-0.36 **	0.55	2.06	0.07	21
Latvia	0.77 **	0.73	[2]	1.10 **	0.50	1.76	0.25	0.77 **	-0.25 **	-0.37 *	0.73	1.70	0.18	0.80 **	-0.25 *	-0.36	0.69	1.74	0.19	14
Lithuania	..	..	NS	0.17	-0.03	1.93	0.32	0.11	-0.14	-0.23	0.12	2.66	0.29	0.03	-0.12	-0.25 *	0.19	2.06	0.29	15
Luxembourg	0.68 **	0.28	[1]	0.68 **	0.28	1.96	0.13	0.75 **	-0.38 **	0.60 **	0.43	2.61	0.11	0.79 **	-0.32 **	0.52 **	0.50	2.09	0.11	21
Malta	..	..	NS	0.87	0.02	2.26	0.21	-0.20	-0.37 *	0.58	0.11	2.18	0.19	0.33	-0.24	0.56	0.03	2.15	0.20	16
Netherlands	0.56 **	0.51	[3]	0.55 **	0.40	2.06	0.11	0.55 **	-0.27 *	0.05	0.53	2.27	0.10	0.56 **	-0.27 *	0.06	0.51	2.08	0.10	21
Poland	..	..	NS	0.00	0.00	2.35	0.16	-0.25	-0.73 *	-0.22	0.13	2.37	0.14	-0.21	-0.60	-0.15	0.14	2.39	0.15	11
Portugal	0.61 **	0.44	[2]	0.63 *	0.22	2.10	0.15	0.61 **	-0.13 *	-0.13	0.44	1.73	0.13	0.64 **	-0.11	-0.14	0.39	2.00	0.13	21
Romania	..	..	NS	1.75	-0.05	1.86	0.38	0.67	-0.35	-0.89	0.08	1.98	0.35	1.08	-0.27	-1.30	0.07	2.27	0.36	10
Slovak Republic	0.90 *	0.55	[3]	0.64	-0.05	1.77	0.29	0.35	-0.27 *	-0.52 *	0.34	1.68	0.22	0.90 *	-0.94 **	-0.61	0.55	1.58	0.19	15
Slovenia	..	..	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Spain	0.63 **	0.67	[3]	0.71 **	0.50	1.60	0.12	0.63 **	-0.08	-0.33 **	0.65	1.36	0.10	0.63 **	-0.09	-0.31 *	0.67	1.81	0.10	20
Sweden	..	..	NS	1.03	-0.06	2.17	1.83	4.10	-0.84 **	-0.07	0.33	2.17	1.42	4.18	-0.76	-0.34	0.28	2.10	1.51	18
United Kingdom	0.98 **	0.98	[1]	0.98 **	0.98	2.05	0.09	2.41	-1.02 **	1.20 *	0.42	2.14	0.50	2.32 *	-0.82	0.89	0.38	2.10	0.52	21
European Union[3]	**0.60**	**0.61**		**0.54**	**0.30**	**1.79**	**0.21**	**0.57**	**-0.26**	**-0.01**	**0.41**	**1.85**	**0.19**	**0.64**	**-0.28**	**-0.03**	**0.41**	**1.84**	**0.20**	

Key: * Statistically significant at 10% level; ** Statistically significant at 5% level.

1. Constant, AR(1) and dummies not shown.
2. See Annex for methodology of model regressions. NA for missing data and too few observations for the regression. NS for estimates which are not statistically significantly.
3. Average calculated over coefficient estimates statistically significant.

Source: OECD calculations, OECD Economic Outlook 93, OECD Social Expenditures, EUROSTAT Cofog for EU28 for unemployment benefits.

Annex Table A1.13 Revisions of personal income and social security tax to output gap 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
Austria	1.66	1.30	0.36	0.10	0.26	0.65	0.60	0.05
Belgium	1.31	1.10	0.21	0.10	0.11	0.71	0.80	-0.09
Bulgaria	1.15	..	..	0.00	..	0.61	..	..
Croatia	1.71	..	..	..	..	0.70	..	..
Cyprus	2.28	..	..	..	..	0.91	..	..
Czech Republic	1.65	1.20	0.45	0.10	0.35	0.86	0.80	0.06
Denmark	1.00	1.00	0.00	0.10	-0.10	0.41	0.70	-0.29
Estonia	1.58	..	..	..	..	1.40	..	..
Finland	1.41	0.90	0.51	0.10	0.41	0.77	0.60	0.17
France	1.86	1.20	0.66	0.10	0.56	0.63	0.80	-0.17
Germany	1.87	1.60	0.27	0.10	0.18	0.60	0.50	0.10
Greece	2.22	1.70	0.52	0.10	0.42	0.58	0.80	-0.22
Hungary	1.73	1.70	0.03	0.10	-0.07	0.76	0.60	0.16
Ireland	1.58	1.40	0.18	0.10	0.08	1.04	0.90	0.14
Italy	1.46	1.80	-0.34	0.10	-0.44	0.58	0.90	-0.32
Latvia	1.50	..	..	..	..	0.81	..	..
Lithuania	1.79	..	..	..	..	1.04	..	..
Luxembourg	1.34	1.50	-0.16	0.10	-0.26	0.39	0.80	-0.41
Malta	2.07	..	..	..	..	0.71	..	..
Netherlands	2.37	1.70	0.67	0.10	0.58	0.62	0.60	0.02
Poland	1.88	1.00	0.88	0.10	0.78	0.97	0.70	0.27
Portugal	1.97	1.50	0.47	0.10	0.37	0.79	0.90	-0.11
Romania	1.29	..	..	..	..	0.62	..	..
Slovak Republic	1.93	0.70	1.23	0.10	1.13	0.89	0.70	0.19
Slovenia	1.63	..	..	..	..	0.66	..	..
Spain	1.84	1.90	-0.06	0.10	-0.15	0.72	0.70	0.02
Sweden	1.32	0.90	0.42	0.10	0.32	0.71	0.70	0.01
United Kingdom	1.68	1.20	0.48	0.10	0.38	0.60	0.90	-0.30
European Union	**1.68**	**1.33**	**0.36**	**0.10**	**0.26**	**0.74**	**0.74**	**0.00**

Source: OECD calculations.

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