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SHOULD MEASURES OF FISCAL STANCE BE ADJUSTED FOR TERMS OF TRADE EFFECTS

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by David Turner

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Should measures of fiscal stance be adjusted for terms of trade effects?

This paper considers the case for adjusting measures of the cyclically-adjusted fiscal balance for exceptional movements in the terms of trade for those countries where production of commodities is a substantial share of output. For such countries exceptional movements in commodity prices, such as have occurred in recent years, are likely to lead to higher tax revenues, most immediately from the companies directly involved in extracting or producing the commodities, but also less directly as the consequent rise in the terms of trade increases real incomes more broadly. A simple method is proposed to allow for exceptional developments in commodity prices using an adjustment based on a concept of the real income gap rather than a real output gap. This method is subsequently applied to Australia – one of the world's leading producers of mined commodities – and the results contrasted with the standard OECD method of calculating the cyclically-adjusted fiscal balance. It is shown that over much of history the two methods generate similar results, but during exceptional periods of rapid change in commodity prices the measures can be very different. The analysis highlights that a key assumption needed to adjust for commodity price developments concerns the equilibrium level of the terms of trade. While the assumption that the terms of trade returns to long-run historical trends might appear a natural benchmark, recent sustained strong growth in demand for commodities from China and other developing Asian economies raises the question as to whether this has led to a permanent increase in the terms of trade of major commodity producers like Australia and has thus permanently raised government revenues.

This Working Paper relates to the 2006 OECD Economic Survey of Australia (www.oecd.org/eco/surveys/australia).

JEL classification: E62, H30, H60.

Keywords: Fiscal policy; public finances; taxation; commodities; Australia.

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Faut-il ajuster les indicateurs budgétaires pour tenir compte de l'incidence des termes de l'échange ?

Ce document examine s'il y a lieu d'ajuster les indicateurs du solde budgétaire corrigé des fluctuations conjoncturelles afin de tenir compte de variations exceptionnelles des termes de l'échange, pour les pays où les produits de base représentent une part importante de la production. Dans ces pays, il est probable que des hausses exceptionnellement prononcées des cours des produits de base, telles que celles qui se sont produites ces dernières années, entraînent un accroissement des recettes fiscales, d'abord en provenance des entreprises qui participent directement à l'extraction ou à la production desdits produits de base puis, plus indirectement, lorsque l'amélioration des termes de l'échange induit une augmentation plus générale des revenus réels. Une méthode simple est proposée pour tenir compte des variations exceptionnelles des cours des produits de base en procédant à un ajustement fondé sur un concept d'écart de revenu réel, et non d'écart de production réelle. Cette méthode est ensuite appliquée à l'Australie – l'un des premiers producteurs mondiaux de produits d'extraction – et les résultats sont comparés à ceux que l'on obtient avec la méthode habituellement utilisée à l'OCDE pour calculer le solde budgétaire corrigé des fluctuations conjoncturelles. On constate que d'une manière générale, les deux méthodes aboutissent à des résultats similaires, mais que pendant les périodes exceptionnelles se caractérisant par des mouvements rapides des cours des produits de base, les indicateurs peuvent être très différents. L'analyse révèle que l'une des principales hypothèses à poser pour tenir compte de l'évolution des cours des produits de base concerne le niveau d'équilibre des termes de l'échange. Bien que l'hypothèse selon laquelle les termes de l'échange retrouvent leurs tendances historiques de long terme puisse paraître la plus valable, la croissance vigoureuse et soutenue de la demande de produits de base émanant de la Chine et d'autres économies d'Asie en développement au cours de la période récente incite à examiner si cette évolution n'a pas entraîné une augmentation permanente des termes de l'échange pour de grands producteurs de produits de base comme l'Australie.

Ce document de travail se rapporte à l'Étude économique de l'Australie 2006 (www.oecd.org/eco/etudes/australie).

Mots clés : Politique budgétaire ; finances publiques ; fiscalité, produits de base ; Australie.

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SHOULD MEASURES OF FISCAL STANCE BE ADJUSTED FOR TERMS OF TRADE EFFECTS?

By David Turner*

Introduction and summary

1. The OECD, as well as other international institutions and national fiscal authorities, regularly compute measures of the cyclically-adjusted fiscal balance as an aid to assessing both the extent to which discretionary year-to-year changes in fiscal policy are expansionary or contractionary and whether fiscal policy is sustainable over the medium term. Such calculations essentially identify components of the fiscal balance which are likely to be transitory because of exceptional developments in real activity, usually measured by the output gap, *i.e.* divergences of output from estimated trend or potential measures.[1] However, for countries where production of commodities is a substantial share of output, it may also be important to identify transitory components of the fiscal balance that are related to exceptional output price developments. Such developments are likely to lead to higher tax revenues, most immediately from the companies directly involved in extracting or producing the commodities, but also less directly as the consequent rise in the terms of trade increases real incomes more broadly. Indeed, Norway, the OECD country which has by far the largest share of commodities (essentially oil) in total production, has long been treated as a special case by the OECD in the calculation of cyclically-adjusted balances.

2. This paper considers whether other OECD countries might appropriately be considered for such special treatment, particularly in the light of the exceptional run up in commodity prices, especially those for oil and metals, in recent years. A simple method is proposed to allow for exceptional developments in commodity prices using an adjustment based on the real income gap rather than output gap. This method is subsequently applied to Australia – one of the world's leading producers of mined commodities – and the results contrasted with the standard OECD method of calculating the cyclically-adjusted fiscal balance. It is shown that over much of history the two methods generate similar results, but during periods of rapid change in commodity prices the measures can be very different. The analysis highlights that a key assumption needed to adjust for commodity price developments concerns the equilibrium level of the terms of trade. While the assumption that the terms of trade returns to long-run historical trends might appear a natural benchmark, recent sustained strong growth in demand for commodities from China and other developing Asian economies raises the question as to whether this has led to a permanent increase in the terms of trade of major commodity producers like Australia and hence permanently raised government revenues.

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* This paper is based on material from the *OECD Economic Survey of Australia* published in July 2006 under the authority of the Economic and Development Review Committee (EDRC), although there has been some refinement in the calculations and methodology used here compared to that reported in the *Survey*. The author would like to thank Val Koromzay, Andrew Dean, Peter Hoeller, Nathalie Girourad, Christophe André, Alexandra Bibbee, Blair Comley and David Gruen for useful discussions and/or comments, with the usual disclaimer. Special thanks go to Desney Erb for technical assistance and to Celia Rutkoski for technical preparation.

3. The remainder of the paper is organised as follows: the next section considers which OECD countries should be considered for special treatment regarding the effect of commodity prices on their fiscal position and the following section proposes a simple method of doing so; in the final section this method is applied to Australia.

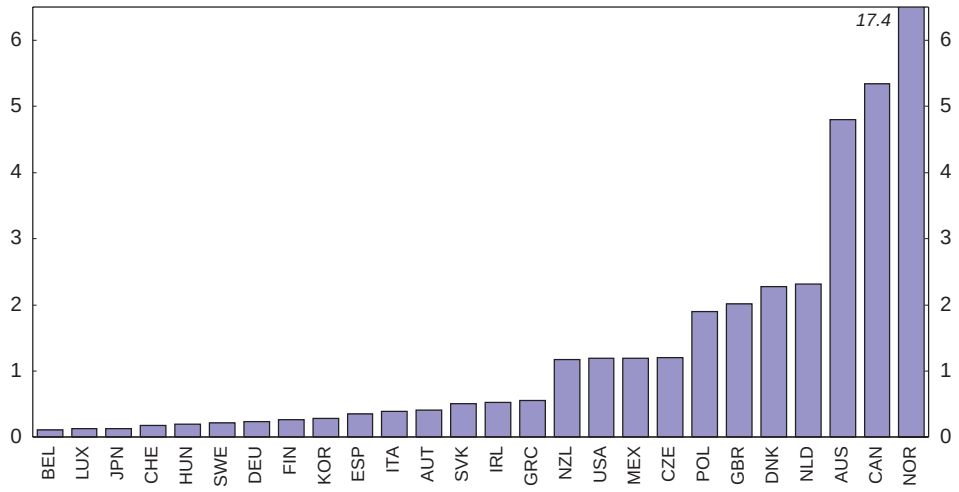
Which countries are candidates for terms-of-trade adjustments to their fiscal stance?

4. A starting point for choosing which OECD countries are appropriate candidates for commodity-induced terms of trade adjustments to measures of their fiscal stance is the share of valued added produced in the mining and quarrying industry (including oil). Norway clearly stands out as the OECD country having by far the highest share of valued added produced in these industries at 17½ per cent of total GDP in 2003 (Figure 1). Next comes Canada and Australia with about 5% of valued added, which is more than double the share of the next OECD country. This ranking is repeated for net exports as a share of GDP (Figure 2). These same countries are also those that have experienced the largest change in the terms of trade since 2001, the period in which global commodity prices have surged (Figure 3), although the largest increase in the terms of trade has been experienced by Australia.[2]

5. These simple rankings confirm the case for treating Norway as a special case in measurements of the fiscal stance. But they also suggest that, particularly in the light of the recent boom in commodity prices, that other countries, most obviously Australia and Canada, might be candidates for special treatment.

Figure 1. Value added in the mining and quarrying industry

In per cent of GDP, 2003[1]

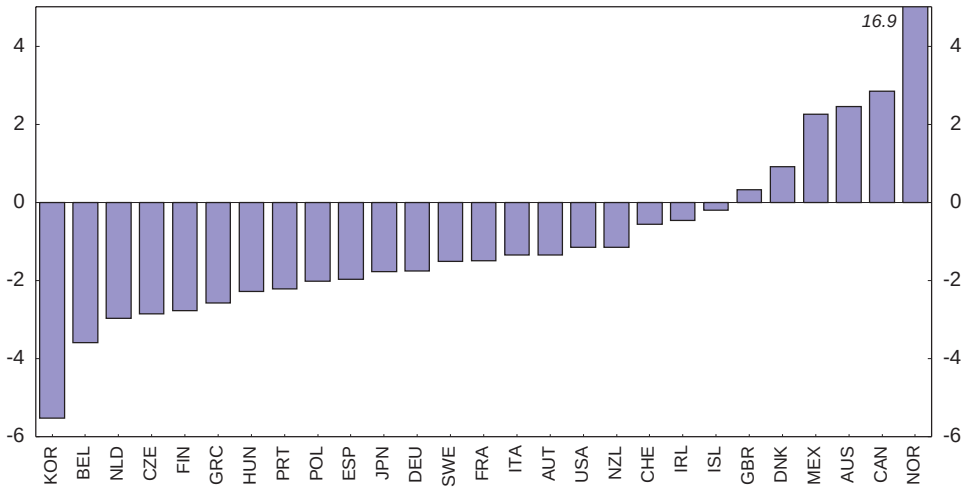


1. 2001 for Australia, Canada and New Zealand; 2002 for Poland and Switzerland.

Source: OECD STAN database, December 2005.

Figure 2. Net exports of goods in the mining and quarrying industry

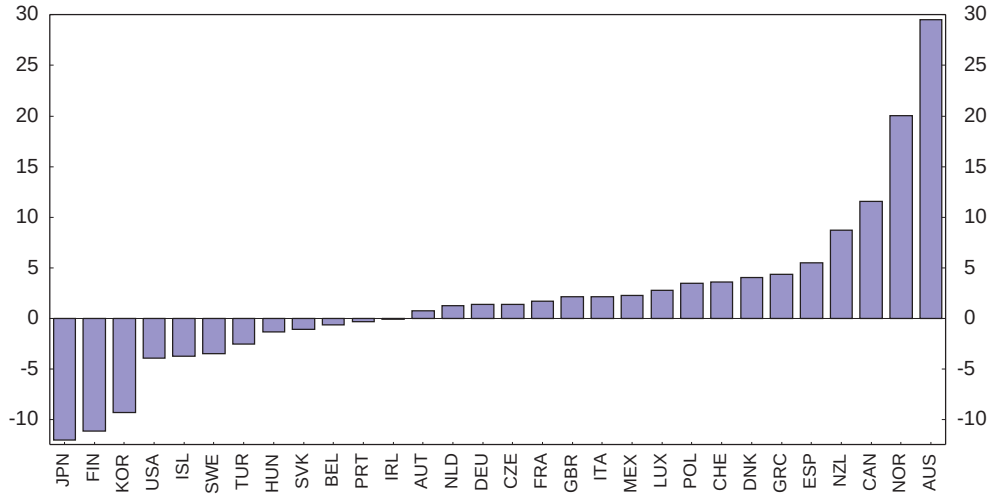
In per cent of GDP, 2003



Source: OECD STAN database, December 2005.

Figure 3. Change in the terms of trade

Per cent, 2001-05



Source: OECD Economic Outlook 79 database.

Adjusting the fiscal stance for exceptional commodity price movements

The example of Norway

6. The simplest method of adjusting measures of fiscal stance for the effects of exceptional movements in commodity prices is to exclude the tax revenues directly relating to the sector producing that commodity, as is done for Norway in the case of oil. Norway has long been treated as a special case in the OECD's calculation of the cyclically-adjusted fiscal balance because of the very substantial government revenues that are derived from offshore oil production. In effect the calculation of the cyclically-adjusted fiscal balance is carried out for 'mainland' Norway with oil tax revenues excluded entirely from the fiscal balance and the output gap on which the cyclical adjustment is based excluding oil production from both actual and potential output. The size of oil tax revenues are very substantial – equivalent to 13% of GDP in 2004 – and vary with the price of oil. If the oil sector was not excluded then changes in oil tax revenues resulting from changes in oil prices would be classified as 'structural' (because they would not be related to the output cycle in Norway), even if the oil price movement proved to be temporary.

7. There are, however, likely to be practical data problems in the timely identification of such tax revenues when they come from more than one commodity and when there is not a specific tax (such as a petroleum revenue tax) to which they directly relate, but rather the additional tax payments are one or more sector's contribution to aggregate company taxes. A more general problem arises if the initial income gains accruing to the profits of companies in extracting or producing the commodities become more widely dispersed. This might occur if there is pressure on wages, or as part of the increased company profits are distributed to shareholders, or (as has been the case in Australia recently, as discussed further below) the additional demand for commodities puts pressure on export-related infrastructure leading to higher investment and increased profitability and income in other sectors.

Adjustments based on the real income gap

8. An alternative approach which overcomes these difficulties is to base the calculation of the transitory components of the fiscal balance on a measure of the real *income* gap rather than the real *output* gap. Real gross domestic income (RGDI) measures the purchasing power of the total incomes generated by domestic production, including the impact on those incomes of changes in the terms of trade; it is equal to gross domestic product at constant prices (RGDP) plus the trading gain (or less the trading loss) resulting from changes in the terms of trade (TT):

[1] $\text{RGDI} = \text{RGDP} \,.\, [1 + xsh \,.\, (\text{TT} - 1)]$,

where '*xsh*' is the share of exports in GDP in the base year used to define GDP volumes and the trade price indices. Potential real income (RGDI*) is then defined when GDP is equal to potential output (RGDP*) and the terms of trade is equal to the equilibrium terms of trade (TT*):

[2] $\text{RGDI}^* = \text{RGDP}^* \,.\, [1 + xsh \,.\, (\text{TT}^* - 1)]$.

9. To make the concept operational, potential output is defined according to the conventional OECD methodology described previously, and, for the time being, the equilibrium terms of trade is defined to be equal to its long run historical average (an assumption which is discussed further below). Then defining the real income gap as log (RGDI/RGDI*) and the real output gap as log (RGDP/RGDP*) it is easily shown that the real income gap is equal to the real output gap plus an additional term related to the divergence of the terms of trade from their equilibrium level:

[3] $\text{Real income gap} = \text{Real output gap} + xsh \,.\, (\text{TT} - \text{TT}^*)$

10. The intuition as to why the fiscal balance, and in particular tax receipts, should be adjusted in line with the real income gap is that an increase in the terms of trade relative to their long-run equilibrium will raise both real domestic income relative to real GDP as well as nominal GDP by boosting the GDP deflator. As tax receipts are quite closely related to nominal GDP, an increase in the terms of trade will also boost tax receipts. The effect of the real income gap on tax revenues can be calculated by applying to it the same semi-elasticities to individual tax components that are applied to the output gap in the standard OECD method of calculating the cyclically-adjusted balance. These semi-elasticities are country-specific and the product of assumptions/estimations regarding the semi-elasticity of the relevant tax base to the output gap and the elasticity of the corresponding tax revenue with respect to its tax base (Girouard and André, 2006). This does, however, raise the possibility of having different elasticities for the terms of trade component of the income gap and the output gap component. For example there may be evidence that a terms of trade shock typically leads to the distribution of income being more skewed towards profits than does a shock to real output. In this case the semi-elasticity applied to corporate taxes can be raised and that applied to personal income taxes lowered, a possibility which is examined below.

Applying the real income gap adjustment to a measure of the fiscal stance for Australia

The effect of the commodities boom on the macroeconomy

11. A main driving force of economic activity in Australia over recent years has been the global boom in mining commodities in which Australia is a major exporter (Table 1 and Figure 4). Exports of resource commodities accounted for more than 40% of all exports by value in 2005, with strong mining profits boosting investment in this sector as well as in related infrastructure.

Table 1. Australia is a major producer of metals and minerals

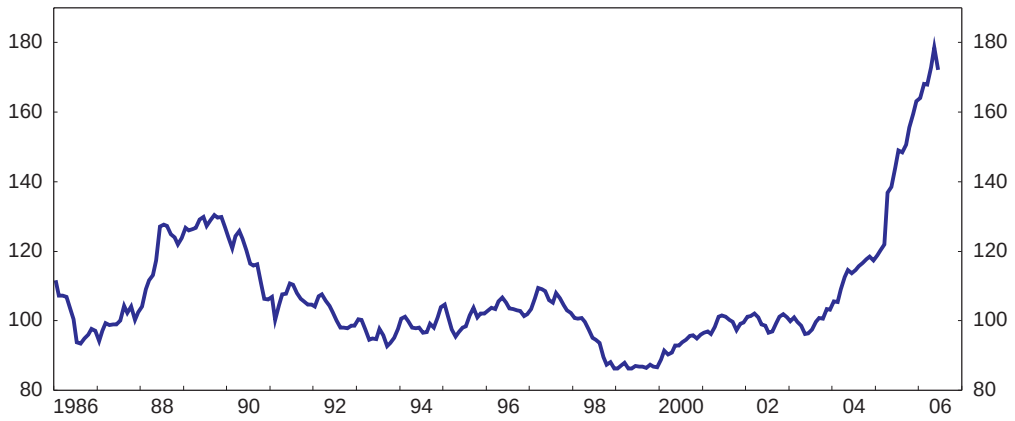
Ranking among all countries

	As exporter	As producer	Reserves
Gold	3rd	5th	2nd
Iron ore	1st	3rd	3rd
Bauxite	. .	1st	1st
Coal	1st	5th	6th
Uranium	2nd	2nd	1st
Nickel	2nd	2nd	1st

Source: Australian Bureau of Agricultural and Resource Economics (ABARE) quoted in Grant *et al*. (2005), "Mining and Commodities Exports", *Economic Roundup*, Spring, The Treasury, Australian Government CanPrint Communications Pty Limited.

Figure 4. Australian commodity prices have been booming

Index (SDR) for all items, 2001/02 = 100

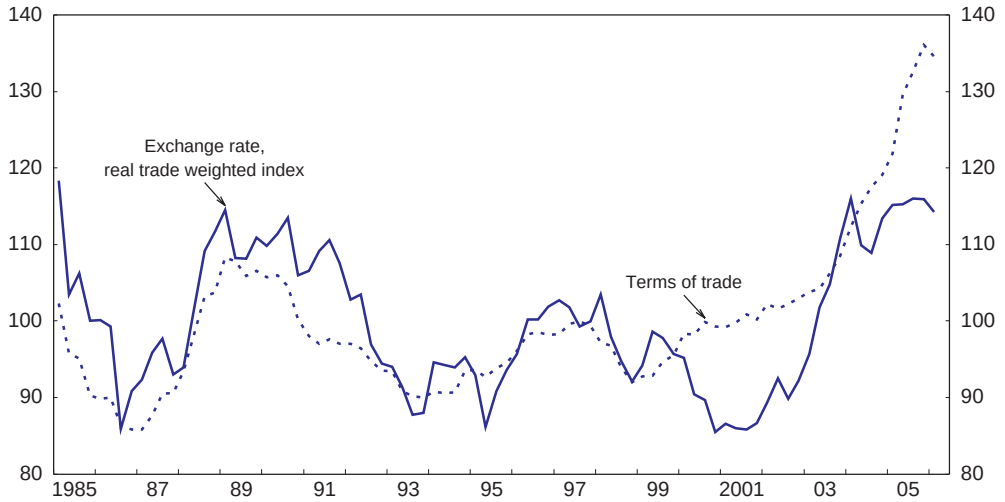


Source: Reserve Bank of Australia.

12. However, the effect of the commodity boom goes well beyond the immediate impact on the resource sector. The terms of trade have risen to a 32-year high (Figure 5), which is reflected in a large differential between real GDP and real gross domestic income growth; in the year to the final quarter of 2005 the former was 2.9%, whereas the latter was 5.6% (Figure 6). Part of the income gain accrues to foreigners given that foreign ownership of the resources sector is significant. However, the majority accrues domestically which stimulates spending and boosts production. The exchange rate has also risen with the terms of trade, although by less than might have been expected on the basis of past relationships (Figure 5). While the appreciation of the exchange rate has limited growth in non-resource export volumes, it has also led to real income gains through lower import prices, encouraging consumption and investment.

Figure 5. Real exchange rate and the terms of trade

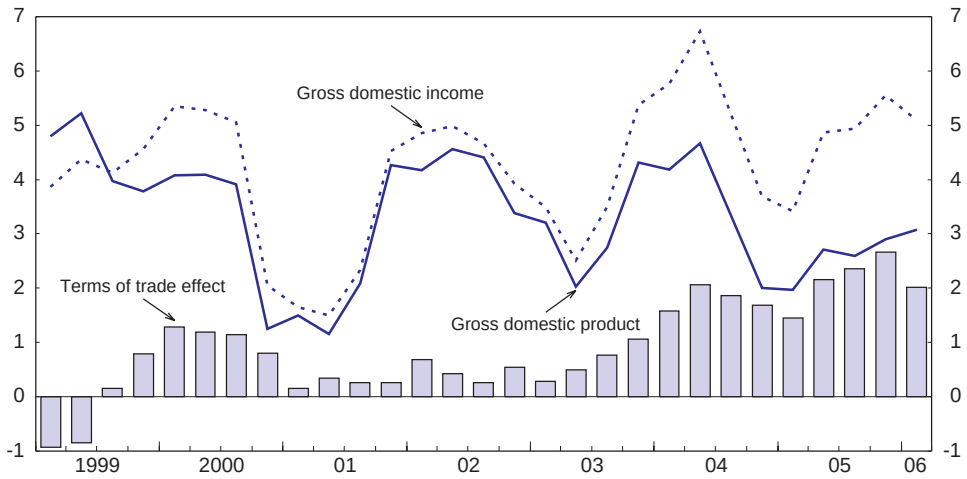
Index, period average = 100



Source: Reserve Bank of Australia and OECD Economic Outlook 79 database.

Figure 6. Real income growth is outpacing real output growth

Percentage change over same period of previous year



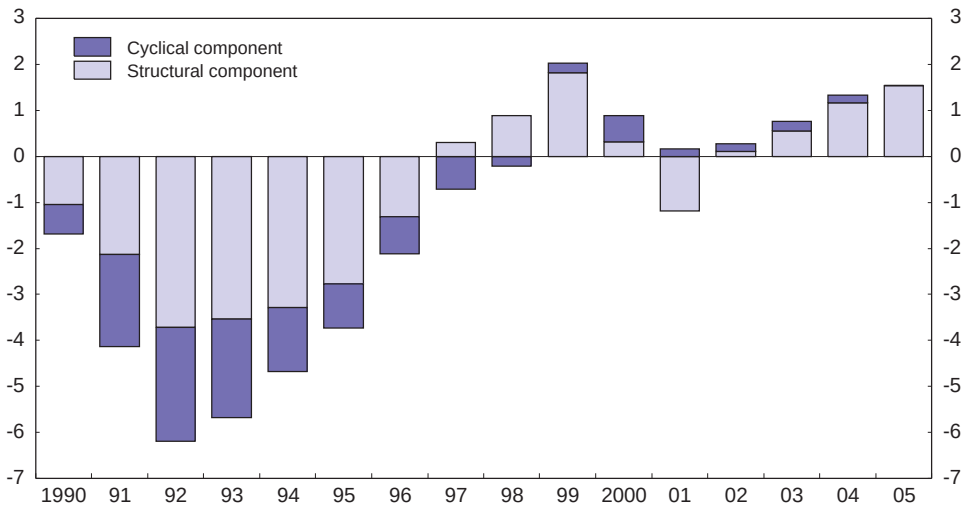
Source: ABS (2006), *Australian National Accounts: National Income, Expenditure and Product* (cat. No. 5206.0).

The fiscal stance based on standard OECD measures

13. The combined balance of the federal and state governments has been in modest surplus in all but one of the last eight years (Figure 7). It slipped temporarily into deficit into deficit in 2001 following the global economic slowdown, but since then the surplus has increased to 1½ per cent of GDP in 2005.[3] A feature of recent federal government fiscal surpluses is that they have consistently exceeded expectations; tax revenues for the immediate year ahead have been under-predicted in each of the last four budgets by an average of about 0.8% of GDP, with much of the under-prediction in corporate taxes (Figure 8). Standard OECD calculations suggest that the surpluses have been essentially structural with the cyclical component averaging only 0.1% of GDP over the last 5 years (Figure 7), corresponding to the relatively small output gap which has been sustained over this period (Figure 9).

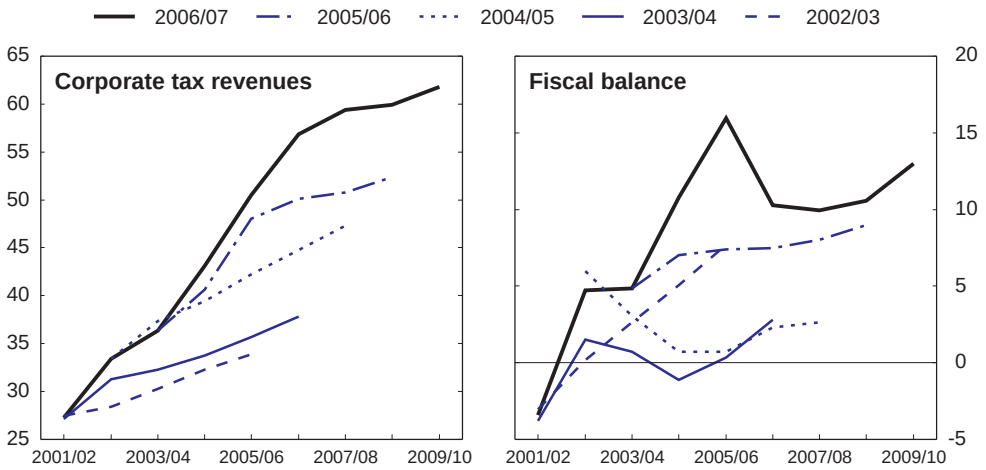
Figure 7. The cyclical and structural component of the fiscal balance for Australia

Using the standard OECD method, in per cent of GDP



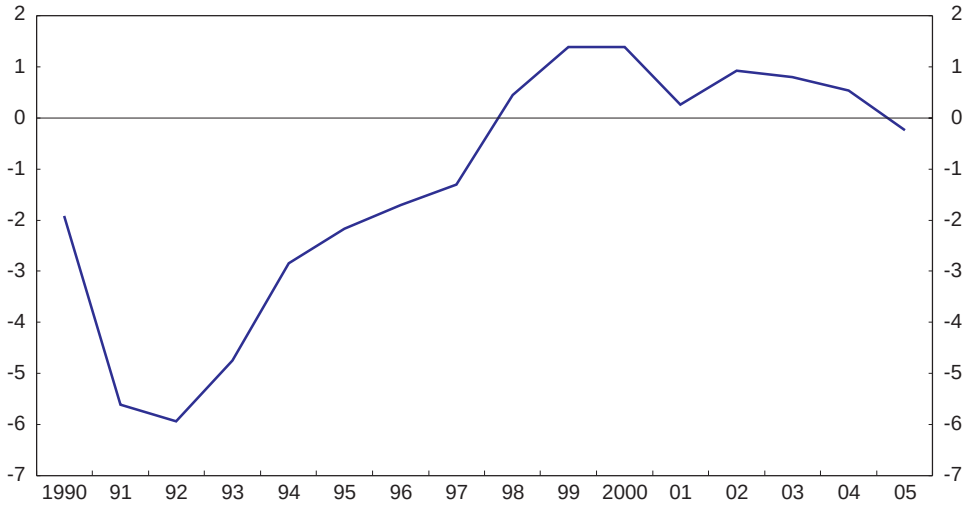
Source: OECD Economic Outlook 79 database.

Figure 8. Fiscal surprises have been repeatedly positive
Successive budget projections, in billion AUD



Source: Australian Government, Budget Papers from various years, www.budget.gov.au.

Figure 9. The output gap
In per cent of potential GDP



Source: OECD Economic Outlook 79 database.

14. However, as previously discussed, the output-gap based calculation and interpretation of the cyclical or transient component of the fiscal balance may convey a misleading picture in the case of commodity-rich countries, where the fiscal position may be particularly sensitive to movements in the terms of trade. Indeed, although the fiscal strategy of the Australian government explicitly refers to the cycle, official scepticism about the practical usefulness of both the output gap and cyclically-adjusted fiscal balances (see for example, Ford, 2005) means that such measures are not published by the government. In this context a macroeconomic model simulation conducted by the OECD on the Treasury's TRYM model is illustrative of the potential problems of cyclically adjusting the fiscal balance in the presence of a terms of trade shock; a rise in world commodity prices *lowers* the level of real GDP (due to the loss of competitiveness of non-resource exports), although it raises real gross domestic income and real gross national expenditure and *boosts* the fiscal balance (Annex A). Clearly in these circumstances the implied

inverse association between the output gap and the fiscal balance does not readily fit with the standard OECD methodology of calculating the cyclical component of the fiscal balance.

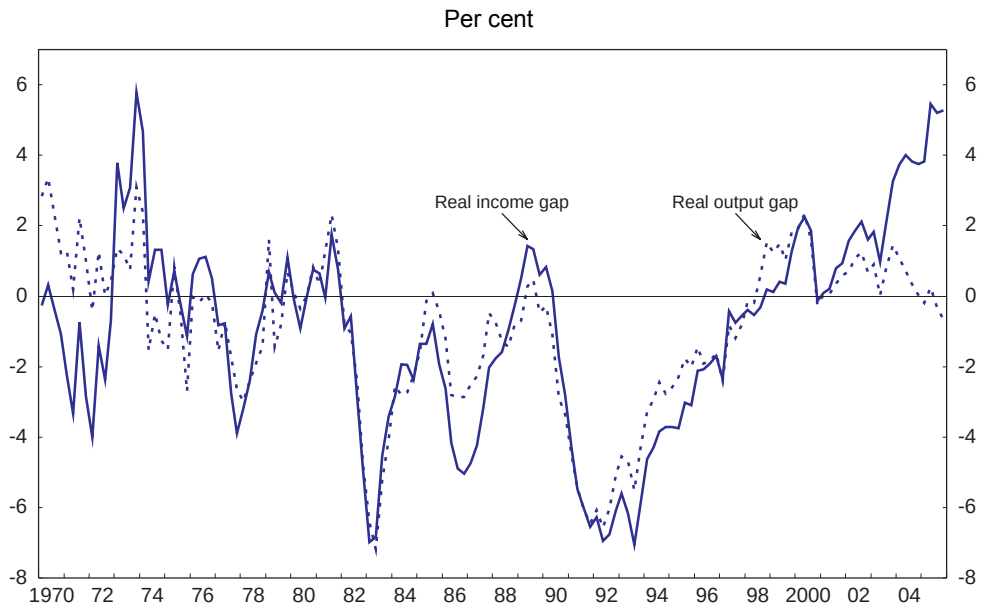
Adjusting the measurement of the fiscal stance for terms of trade effects

15. Following the earlier discussion an alternative calculation of the transitory component of the fiscal balance is calculated for Australia. The first stage in this calculation is to compute a measure of the real income gap on a comparable basis to the OECD's standard measure of the real output gap. The real income gap is here defined to be the same as the output gap when the terms of trade are at their equilibrium level, which is here taken to be the long-run historical average, thus:

[4] Real income gap = [(real domestic income/potential output) -1 - α],

where real domestic income is the national account series calculated by the Australian Bureau of Statistics, potential output is the OECD measure of potential output and α is a constant that ensures that the average real income gap is equal to the average real output gap over history. The magnitude of the difference between the two gap measures is mostly small; in the last 3 decades there are only two years when the difference has exceeded 2 percentage points (Figure 10). However, these two years are 2004 and 2005 with the real income gap in 2005 exceeding 5 per cent compared to the standard OECD measure of the output gap of roughly zero.

Figure 10. Real income and real output gaps



Source: ABS (2006), *Australian National Accounts: National Income, Expenditure and Product* (cat. No. 5206.0) and OECD Economic Outlook 79 database.

16. The second stage of the calculation is to decide on the appropriate semi-elasticities to apply to the various tax revenue components (household direct taxes, business income taxes and indirect taxes)[4] in respect of the real income gap. The OECD method of determining these country-specific elasticities with respect to the output gap relies on various estimations and assumptions (see Girouard and André, 2006):

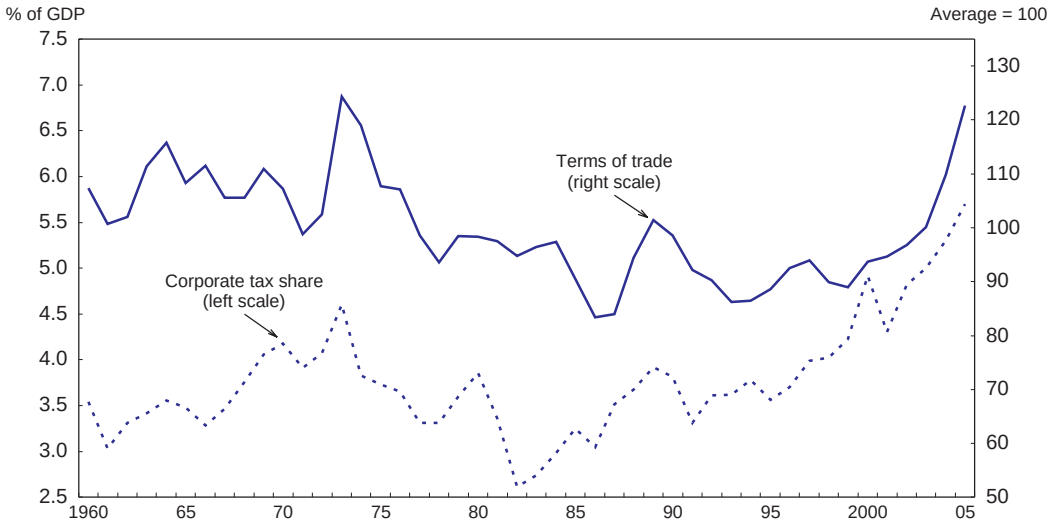
- The semi-elasticity of the tax bases, wages and profits, is inferred from a regression of the wage share on the output gap.

- The elasticity of personal income taxes with respect to wage income is calculated using micro simulation models of the income tax system, although company taxes are assumed to change proportionately with profits.

- The semi-elasticity of indirect taxes with respect to the output gap is assumed to be unity.

17. The simplest way of proceeding would be to apply these same assumptions to the measure of the real income gap. However, there are reasons for believing that profits and company taxes are more responsive to a change in the real income gap resulting from a change in the terms of trade than from a change in the output gap. There is a much stronger correlation between the terms of trade and company tax receipts than between the output gap and company tax receipts (Figure 11). The recent surge in commodity prices is partly responsible for raising corporate taxes to 5.7% of GDP in 2004, 2 percentage points above the average since 1960, and the third highest in the OECD after oil producers Norway and Mexico.[5,6]

Figure 11. Corporate tax share and the terms of trade



Source: OECD Economic Outlook 79 database.

18. Following Girouard and André (2006), the elasticities of the tax bases, wage and profits, are inferred from simple regressions of the wage bill on gap measures, although as a check on these results the corresponding regression on profits is also run (see Annex B for details). When the regressions are run with just the output gap as the explanatory variable the point estimates of the semi-elasticities -- 0.7 for wages and 1.4 for profits -- are very close to those reported by Girouard and André (2006). The regressions are then run on the real income gap split into two components, the output gap and the terms of trade component of the income gap (*i.e.* the income gap minus the output gap). Both the wage and profit equations suggest that profits are more sensitive (and wages correspondingly less sensitive) to the terms of trade component of the income gap than they are to the output gap. Averaging the point estimates across the two equations suggests a semi-elasticity with respect to the terms of trade component of the output gap of 0.36 for wages and 1.96 for profits. Under the assumption adopted by Girouard and André (2006), that corporate taxes increase proportionately with the tax base, this implies a semi-elasticity of corporate taxes with respect to the terms of trade component of the real income gap of about 2.0 (Table 2). Moreover, given an assumption for the elasticity of income tax with respect to wages of 1.5 as adopted by Girouard and André (2006), the semi-elasticity of income taxes with respect to the terms of trade component of the real income gap is estimated to be 0.54.

Table 2. Tax elasticity assumptions

Semi-elasticity with respect to the output or income gap

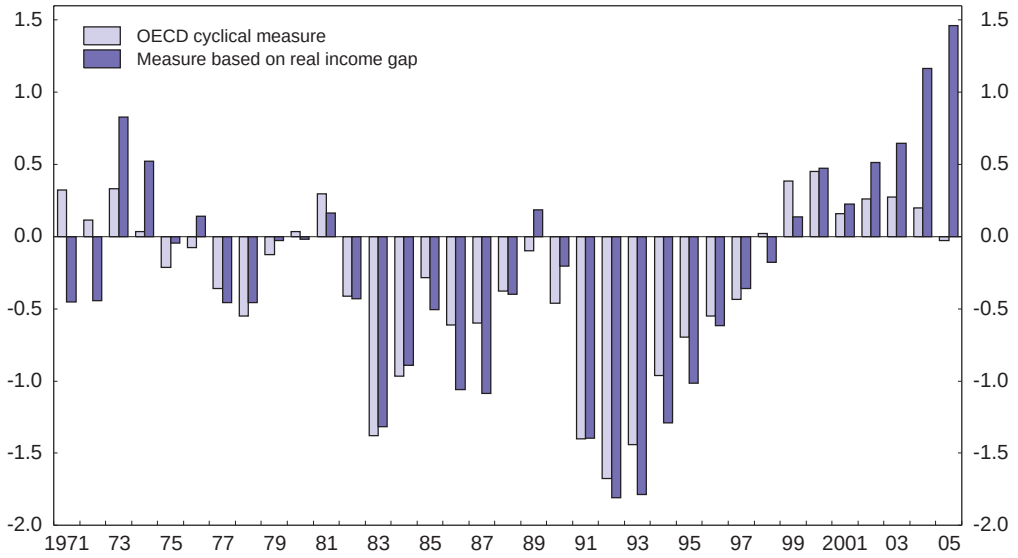
	Standard OECD method using the output gap	Adjustment using the real income gap	
		Output gap component	Terms-of-trade component
Personal income tax	1.04	1.04	0.54
Company tax	1.45	1.45	1.96
Indirect tax	1.00	1.00	1.00

Source: Girouard and André (2006), and authors own calculations.

19. The final stage in the calculation is to apply the elasticities in Table 2 to the estimated real income gap in Figure 10. The resulting estimates of the transient component of tax revenues are similar to the standard OECD calculation over much of history, but in recent years the difference is more substantial (Figure 12); based on the real income gap the temporary component of the fiscal balance is about 1½ per cent of GDP in 2005, whereas, according to the standard OECD methodology it was close to zero.

Figure 12. The transient component of tax revenues

Per cent



Source: ABS (2006), *Australian National Accounts: National Income, Expenditure and Product* (cat. No. 5206.0) and OECD Economic Outlook 79 database.

What is the appropriate assumption regarding the equilibrium level of the terms of trade?

20. An important caveat to the calculation based on the income gap concerns the assumption that the equilibrium terms of trade will revert to their long-run historical average. An extreme alternative assumption would be that the current elevated terms of trade represent a new sustainable equilibrium, in which case the real output and real income gaps would coincide and so imply that the transient component of the fiscal balance is negligible. The official view underlying the recent federal budget lies between these two extreme cases, namely that the terms of trade are likely to fall in future years, but remain at levels well above the long-run historical average. This is consistent with a view that the prospective growth of China, together with gains from being a substantial net importer of information and communication technology

products (for which there has been a trend fall in prices), have led to a permanent favourable shift in the terms of trade. In particular, on a per capita basis, China lags well behind developed regional neighbours such as Japan and Korea in terms of consumption of a range of resources and resource intensive products such as steel (Maurer *et al.*, 2004). It is also consistent with recent empirical analysis by the IMF (2006) which concludes "*Over the medium term, however, metals prices are expected to retreat from recent highs as new capacity comes on stream, although probably not falling back to earlier levels – in part because higher energy prices have increased production costs*". On the basis of the budget assumption that the terms of trade eventually fall from 28% above the long-run historical average (since 1960) to about 14% above it (but only by 2008/09), the transient component of the fiscal balance would currently be about ¾ per cent of GDP, which compares to a projected general government surplus (for the Australian government and the states) of ½ per cent of GDP in 2006/07.

NOTES

1. The OECD's method of computing the cyclically-adjusted fiscal balance is described fully in Giorno *et al.*, (1995). For tax revenues the cyclical components are calculated by taking the divergence of output from estimates of potential output, *i.e.* measures of the output gap, and multiplying them by estimated elasticities with respect to output. In terms of revenues, four different types of taxes are distinguished in the cyclical adjustment process: personal income tax; social security contributions; corporate income tax and indirect taxes. The sole item of public spending treated as cyclically sensitive is unemployment-related transfers. For the most recent update of the tax elasticities which are used to calculate the cyclical component of tax revenues see Girouard and André (2005). For a description of recent modifications to the method used to calculate potential output see Beffy *et al.* (2006).

2. Chile has a well-functioning, fiscal mechanism for smoothing copper-related fluctuations in government revenue through the Copper Stabilisation Fund (OECD, 2005).

3. Australian fiscal balances are usually discussed on a financial year basis (starting in June) whereas the OECD typically reports fiscal balances on a calendar year basis to improve cross-country comparability.

4. For other OECD countries a cyclical adjustment is also made to social security contributions, but in Australia there are none.

5. There may, however, be other factors which have been boosting corporate taxes. An internal review (see Box 1 on page 5-7 of Australian Government, 2005) by the Treasury concluded, without quantifying their contribution, that these comprise: the privatisation of major government business enterprises; growth in capital gains made by companies; the long period of economic expansion which has reduced the stock of carried-forward losses to offset tax payable; more effective tax compliance activities of the Australian Taxation Office; and increased incentives to pay tax.

6. The three major OECD commodity producers – Australia, Canada and Norway – are the only OECD countries for which there is a statistically significant (at the 5% level) positive correlation between the terms of trade and the corporate tax share over the last 3 decades.

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ANNEX A. TREASURY MODEL SIMULATIONS OF A TERMS OF TRADE SHOCK

21. This annex reports a model simulation by the Australian Treasury's TRYM large-scale macro model as an additional method of assessing the fiscal implications of a terms of trade shock. The TRYM simulation suggests that a shock to the terms of trade of 7%, caused by an increase in world commodity prices, would raise the fiscal balance by about ½ per cent of GDP over the first two years (panel A of Table A1). An interesting feature of the simulation results is that the initial effect on GDP and employment is negative, due to the loss in competitiveness of non-resource exports as the exchange rate appreciates, but that there are strong positive effects on the volume of gross national expenditure. An implication of the initial adverse GDP effect is that conventional cyclical measures of the budget balance, which are related to movements in the level of GDP away from trend, might (erroneously) impute a negative transitory fiscal effect of the terms of trade shock.

Table A1. Treasury model simulation of a shock to the terms of trade[1]

	Units	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Terms of trade	%	7.16	7.23	7.14	7.10	7.11	7.15
Real exchange rate	%	5.90	5.54	5.19	4.88	4.64	4.48
GDP growth	% points pa	-0.80	0.17	0.37	0.38	0.37	0.34
GNE growth[2]	% points pa	0.08	0.34	0.45	0.42	0.36	0.35
Employment growth	% points pa	-0.21	0.06	0.24	0.27	0.26	0.23
Inflation – consumption deflator	% points pa	-2.02	-2.04	-1.87	-1.57	-1.18	-0.74
Government borrowing	% points of GDP	-0.61	-0.50	-0.38	-0.32	-0.30	-0.29
Current account balance	% points of GDP	0.51	0.45	0.25	0.09	0.05	0.04

1. Shock to the terms of trade occurs through an increase in the price of commodity exports.
2. Gross national expenditure growth.

Source: The Treasury, Australian Government.

ANNEX B. EXAMINING THE SENSITIVITY OF WAGES AND PROFITS TO INCOME AND OUTPUT GAPS

22. Girouard and André (2006) derive the sensitivity of the tax bases, wages and profits, to the output gap (OGAP), from a regression on annual data of the following form:

(B1) $\Delta \log (\text{Wage Bill})/ Y^* = a_0 + a_1 \Delta \ln (1+\text{OGAP}/100)$,

where Y* is potential output and a correction is made for first order AR(1) correlation in the residuals. The coefficient a_1 is then interpreted as the short-run elasticity of the wage bill with respect to the output gap. The elasticity of profits with respect to the output gap is then inferred given an assumption about the size of the profit share (*i.e.* the responsiveness of profits is assumed to be proxied by the reciprocal of the wage bill equation).

23. For the current exercise this regression is rerun over an extended sample (1970 to 2005), together with a second equation, run as a check, in which the wage bill is replaced by a measure of profits (here taken to be the variable business income (YB) from the OECD's Analytical Database (ADB) which is defined as a residual after deducting the wage bill and other items from nominal GDP):-

(B2) $\Delta \log (\text{Profits})/ Y^* = b_0 + b_1 \Delta \ln (1+\text{OGAP}/100)$.

24. These equations are then augmented by a term measuring the difference between the income gap (IGAP) and output gap, which corresponds to the 'terms of trade' component of the income gap:

(B3) $\Delta \log (\text{Wage Bill})/ Y^* = a_0 + a_1 \Delta \ln (1+\text{OGAP}/100) + a_2 \Delta \ln (1 + (\text{IGAP} - \text{OGAP})/100))$,

(B4) $\Delta \log (\text{Profits})/ Y^* = b_0 + b_1 \Delta \ln (1+\text{OGAP}/100) + b_2 \Delta \ln (1 + (\text{IGAP} - \text{OGAP})/100)$.

25. The results from these regressions are summarised in Table B1, where '*' and '**'denote that a coefficient is significant at the 5% and 1% level of significance, respectively.

Table B1. Regression results, responsiveness of wages and profits to gap variables

Regression	Coefficient				Rsqd
	a_1	a_2	b_1	b_2	
B1	0.74 **	. .	. .	. .	0.61
B3	0.70 **	0.20	. .	. .	0.61
B2	. .	. .	1.39 **	. .	0.29
B4	. .	. .	1.19 **	1.70 **	0.40

These estimation results can be used to derive elasticities of wages and profits with respect to the gap variables either directly, or indirectly given an assumption that the profit share is 40%. Thus, if the elasticity of the wage bill relative to the output gap is estimated to be θ from a regression (such as B1 or B3) and the profit share is π, then the elasticity of profits with respect to the output gap is indirectly derived as $\{1 - (1-\pi)\,\theta\}/\,\pi$.

Table B2. Implied elasticities of wages and profits to gap variables[1]

	Elasticity with respect to output gap		Elasticity with respect to (income - output gap)	
	Wages	Profits	Wages	Profits
Girouard and André (2006)	0.70	(1.45)	. .	. .
Regression:				
B1	0.74	(1.39)	. .	. .
B3	0.70	(1.45)	0.20	(2.20)
B2	(0.74)	1.39	. .	. .
B4	(0.87)	1.19	(0.53)	1.70
Final preferred estimates	**0.70**	**1.45**	**0.36**	**1.96**

1. Figures in brackets are inferred indirectly assuming a profit share of 40%.

Given that the estimates of the elasticities of both wages and profits with respect to the output gap are all similar to those of Girouard and André (2006) which are used in the standard OECD method, their estimates are retained for the purposes of the calculations reported in the main paper. However, the elasticities with respect to the terms-of-trade component of the income gap are significantly larger (smaller) with respect to profits (wages), comparing the second (first) and fourth (third) columns. For the calculations reported in the main paper an average of these estimates is therefore adopted (see the final row of Table B2).

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