

ANNEX 2.A2

Incorporating Terms-of-Trade Gains and Losses into International Income Comparisons

Substantial changes in the relative prices of internationally traded goods have taken place over the past decade, most notably wide swings in oil and raw material prices and a continuous decline in the price of information and communication technology (ICT) goods. These price changes have inserted a wedge between production and real incomes in countries with relatively strong or weak specialisation in the goods concerned. Improvements in the terms of trade amount to a windfall gain for a country as a whole, and imply an increase in its real income and material well-being even under unchanged output. Put simply, an improvement in the terms of trade means a country gets more for less. This phenomenon is similar in many ways to technological progress. Contrary to the treatment of technological progress, however, a change in the terms of trade is treated by the System of National Accounts as a price phenomenon, rather than a real effect. Consequently, the beneficial effect of an improvement in the terms of trade is not captured by real GDP measures.¹

Previous work by the OECD, reported in particular in *Going for Growth 2006*, evaluated a range of national accounts-based measures of material well-being, including real gross national income, which takes account of terms-of-trade effects and also makes adjustments for net foreign transfers from abroad that in some cases can be quite large (Boarini *et al.*, 2006). This earlier work did not examine real gross domestic income (GDI) at PPP, a measure whose computation has recently gained a clearer methodological foundation, as the index number properties of its deflators relative to those of the standard GDP measure have been more systematically evaluated (Feenstra *et al.*, 2009; Reinsdorf, 2009).

This annex uses newly-derived computations of real GDI to compare income and output across OECD countries and over time. The analysis finds that taking account of the terms of international trade can indeed be important for assessing *both* changes and cross-country differences in real income, and thereby in material well-being. Regarding *changes* in real income, the gap between real GDI and real GDP per capita growth has exceeded one percentage point annually in several OECD countries over the past decade, confirming that terms-of-trade effects can undermine the accuracy of real GDP per capita growth as an indicator of advances in material living standards. Regarding *real income levels*, and given the conventions used in constructing OECD GDP PPPs, the current *Going for Growth* practice of comparing real GDP per capita levels across countries using PPPs comes in fact close – although it is not fully equivalent – to comparing real GDIs per capita, and as such it

already largely incorporates terms-of-trade effects. One option going forward would be to use explicit real GDI per capita measures for benchmarking purposes in the context of *Going for Growth* – regardless of whether other, more radical, changes to performance benchmarks are considered, such as further development of the types of measures discussed in the conclusions to the recent report of the Commission on the Measurement of Economic Performance and Social Progress (see Box 2.1 in Chapter 2).

From output (real GDP) to income (real GDI)

A number of OECD countries have experienced strong trend changes in their terms of trade over the past decade. For instance, Australia has benefited from a strong improvement in its terms of trade as a result of large increases in commodity prices, while Finland has experienced a terms-of-trade decline as a result of rapid falls in the price of its ICT good exports. Such large shifts in the prices of exports relative to those of imports drive a wedge between the value of production and real incomes, and can offset some of income gains from productivity growth when the latter is concentrated in goods and services that suffer relative price declines on world markets, such as ICT goods. Given that the broadening of globalisation has favoured greater degrees of specialisation, especially for relatively small countries, taking into account gains and losses from the terms of trade is of growing relevance.

In recent years, some effort has been made in the measurement literature to examine the evolution of real GDI and incorporate the terms of trade effects into income computations for certain OECD countries, such as Canada, Switzerland and the United States, among others (see Kohli, 2004, 2006; Reinsdorf, 2009). The main implication is that if the objective is to compare relative incomes across countries and changes over time, then real GDI should be preferred to real GDP, though for productivity measurement the focus should continue to be on real GDP.

The distinction between real GDP and real GDI is made in the UN System of National Accounts, though there is no conceptual difference between *nominal* GDP and GDI.² However, *real* GDP and GDI can differ because their deflators are different. More precisely, the latter may be defined as:³

$$\text{Real GDI} = (\text{Nominal GDP}) / (\text{Domestic absorption price index})$$

where domestic absorption equals consumption plus investment and government expenditure (C + I + G), or equivalently GDP minus the trade balance, the latter being defined as exports minus imports (X - M). In comparison, the traditional output-based concept defines:

$$\text{Real GDP} = (\text{Nominal GDP}) / (\text{GDP price index})$$

and thus, the difference in the concepts is only on account of the difference in their deflators:

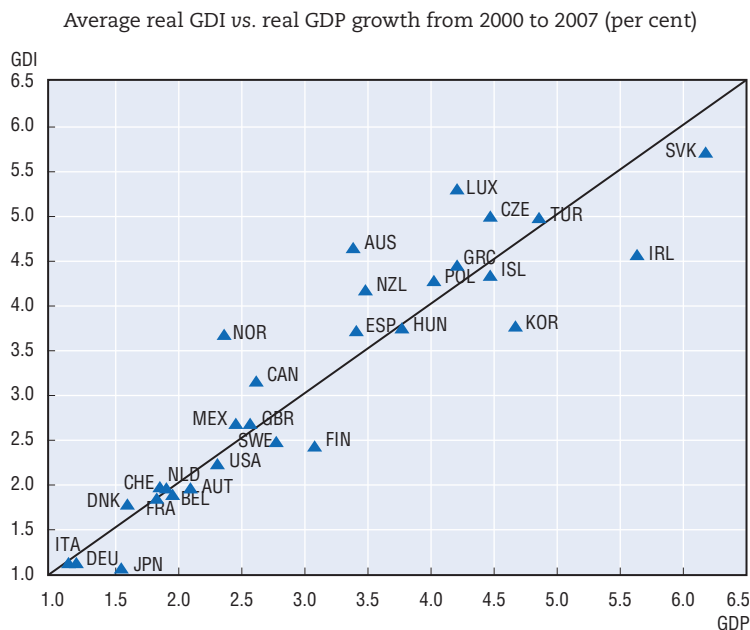
$$\text{Real GDI} - \text{Real GDP} = \frac{X - M}{P_{da}} - \left(\frac{X}{P_x} - \frac{M}{P_m} \right)$$

where P_{da} is the price index for domestic absorption and P_x and P_m are the price indexes for exports and imports, respectively. Thus, computing real GDP in domestic currency amounts to deflating each component of GDP by corresponding deflators (*i.e.* the export and import price deflator for exports and imports, respectively), while computing real GDI implies deflating the whole trade balance by the price index for domestic absorption.

Real GDI affects the evolution of income measures over time

Over the past decade, real income growth has varied substantially for some countries according to whether it is measured by the evolution of real GDI or by changes in real GDP. Depending on the composition of trade, and focusing on the period 2000-2007, countries can be separated into those that gained and those that lost in effective terms as a result of shifts in their terms of trade (Figure 2.A2.1). Annual real GDI growth exceeded real GDP growth by over one percentage point in Australia and Norway as a result of favourable shifts in commodity prices over the period. Canada and New Zealand also benefited, albeit to a lesser extent. Other countries that enjoyed sizable terms-of-trade gains include the Czech Republic, Luxembourg and Spain. By contrast, Ireland, and to a lesser extent Finland, Japan, the Slovak Republic and Sweden suffered significant terms-of-trade losses over the 2000 to 2007 period.

Figure 2.A2.1. **Real income growth differs noticeably from real GDP growth in a number of OECD countries**



Source: OECD National Accounts Database.

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Just like focusing on real GDI growth can yield a different income growth picture than looking at real GDP growth, focusing on real GDI levels can significantly alter cross-country differences in income levels compared with comparisons based on real GDP levels. In order to make comparisons of income levels across countries, domestic currency values need to be converted using appropriate purchasing power parities (PPPs). Own-currency GDP is usually deflated for international comparison using the GDP PPP, while own-currency GDI should be deflated using the PPP for domestic absorption only, analogous to the use of the domestic absorption price index for deflation over time (see Feenstra *et al.*, 2009). These concepts in level terms can be defined as follows:

$$\text{Real GDP at PPP} = (\text{Nominal GDP}) / (\text{PPP for output})$$

$$\text{Real GDI at PPP} = (\text{Nominal GDP}) / (\text{PPP for domestic absorption})$$

The deflation procedure that is used for converting GDP in a country's own currency to international dollars at PPP, in use by the OECD and other international organisations, is actually closer in practice to GDI than to an output-based concept. This means that it is actually straightforward to compute purely GDI-based PPPs. And because published GDPs at PPP already capture some terms-of-trade effects, they are fairly appropriate for international comparisons of income levels, but raise some issues for output and productivity level comparisons (see Box 2.A2.1). GDI-based PPPs for the 2005 benchmark year may then be used in combination with inter-temporal GDI deflators (using domestic absorption) over time to compute a real income (real GDI) measure that is comparable both over time and across countries.

Box 2.A2.1. The difference between the “true” real GDP and real GDI in levels at PPP

The distinction between the income (GDI-based) and the output (GDP-based) deflator concepts implies that changes in the terms of trade will affect the growth rates of GDI and GDP differently. However even the relative levels between countries differ according to which concept is used, because the PPP is not the same for domestic absorption and for overall GDP. In order to correctly measure the terms-of-trade effect in levels across countries and therefore to make accurate international comparisons of output, reliable PPPs for both imports and exports are needed. Experimental work has been carried out using import and export unit value ratios for traded goods to derive PPPs, which attempt to control for major differences in the composition of trade (Feenstra *et al.*, 2009).¹ Using this rough approximation, it appears that cross-country differences in output levels can vary dramatically from cross-country gaps in incomes. This can be observed by examining the difference between the concepts:

$$GDI_{GDI\ PPP} - GDP_{Output\ PPP} \approx \left(\frac{PPP_x}{PPP_{da}} - 1 \right) \left(\frac{X}{PPP_x} \right) - \left(\frac{PPP_m}{PPP_{da}} - 1 \right) \left(\frac{M}{PPP_m} \right) \quad (1)$$

where PPP_x and PPP_m are the purchasing power parities for exports (X) and imports (M), respectively.

In fact, Feenstra *et al.* (2009) estimate that the differences between the income (GDI) and output (GDP-based) concepts can be very large in levels. Taking extremes, in 1996, real GDI at international prices – which is not far from the real GDP at PPP as currently measured and used for benchmarking purposes in *Going for Growth* (see below) – exceeded real output by more than 15% in Ireland, Mexico and Switzerland, while real output was over 15% higher than real GDI in Iceland and Norway. In order to correctly assess labour productivity gaps across countries, separate from terms-of-trade effects, this output-based concept should be computed.

What is the current practice at the OECD? The recommendation by the Eurostat-OECD PPP Manual is to use the “Standard” GDP PPP to compute the level of GDP per capita for a comparison year. In applying this GDP PPP measure to GDP, because PPPs for exports and imports are difficult to measure, they are approximated by the market exchange rate, implicitly assuming the law of one price holds for tradables. By making this approximation – and using the same deflator for both imports and exports, the “Standard” GDP PPP in fact to a large extent takes into account, for that given year, the level of the terms-of-trade effect. As a result, the “Standard” GDP PPP comes closer in practice to a GDI at PPP than to

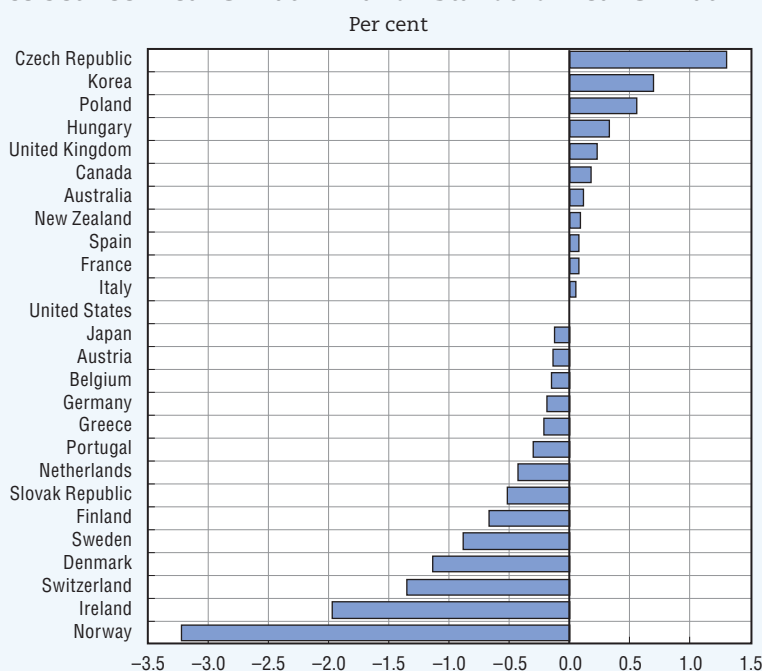
Box 2.A2.1. The difference between the “true” real GDP and real GDI in levels at PPP (cont.)

an output measure at PPP. This can be observed by replacing PPP_x and PPP_m in equation (1) with the exchange rate, $exch$, to obtain:

$$GDI_{GDI\ PPP} - GDP_{\text{“Standard”}\ GDP\ PPP} = \left(\frac{exch}{PPP_{da}} - 1 \right) \left(\frac{X - M}{exch} \right) \quad (1')$$

In the case of balanced trade, the OECD’s GDP at “Standard” GDP PPP measure is in fact equal to the above GDI at PPP measure. In the case of *unbalanced* trade, while it would be conceptually preferable to use the domestic absorption PPP to compute GDI at PPP, the difference between the “Standard” measure that is current employed by the OECD and an ideal GDI PPP measure is in fact relatively small, as shown in the figure below for the benchmark year 2005.

Difference between real GDI at PPP and “Standard” real GDP at PPP in 2005



Note: Real GDI is obtained using the PPP for domestic absorption, while real GDP uses the OECD’s “Standard” GDP PPP.

Source: Calculated from the OECD National Accounts Database.

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Despite the conceptual similarity (particularly as compared to an “ideal” output-based PPP concept) between the GDI at PPP and the OECD’s “Standard” GDP PPP, the differences are not negligible, ranging from negative 4.2% of GDP for Ireland to positive 2.5% for Australia. For this reason, Figure 2.A2.1 in this annex uses purely GDI-based PPPs rather than the OECD’s “Standard” GDP PPPs.

1. These estimates rely on unit values for traded goods at the four-digit SITC level to determine their relative price parities for the construction of import and export PPPs. They implicitly assume that there are no quality differences among traded goods at this level. This is a very strong assumption, and the treatment differs from that in much of the intra-industry trade literature, where international differences in unit values are seen as evidence of quality differences. While there has been work to separate quality from price by Hallak and Schott (2008), which suggests that quality differences may be less of an issue for OECD countries, this analysis remains highly experimental. Thus, these estimates of the difference between real GDI at GDI PPPs and real GDP at output-based PPPs should be considered as indicative of the overall scale of the measurement problem rather than as point estimates in themselves.

Do terms-of-trade issues have implications for *Going for Growth's* assessments and policy recommendations?

Much of the empirical work that underlies *Going for Growth* policy recommendations relies upon GDP-based national accounts aggregates as their explanatory variables. In particular, dynamic panel regressions have been estimated that explore the policy and institutional drivers of either labour productivity growth (GDP per capita or GDP per worker) or GDP-based total factor productivity growth. While these measures avoid the problems discussed above with the level of GDP at PPP, since they rely on growth rates, they do not take into account terms-of-trade gains and losses.

Whether ignoring terms-of-trade changes affects the policy recommendations derived from previous OECD empirical studies is unclear *a priori*. Insofar as terms-of-trade changes are distributed randomly across countries, or at least are unrelated to the structural policies which have been identified as significant influences on productivity growth, policy conclusions drawn from previous OECD work are unaffected. This is no longer the case, by contrast, if certain structural policies have side effects on terms of trade and income which have been overlooked thus far. Unfortunately, it is difficult to discriminate between these two possibilities in practice, due to lack of empirical evidence on the export and import price effects of structural policy reforms.

One open question is whether the productivity-enhancing effects of reforms may have been partly offset – in terms of their impact on incomes – by terms-of-trade declines in some OECD countries since the mid-1990s. In a few small open economies for instance (*e.g.* Finland), structural reforms have been concomitant with increased specialisation in information and communication technology goods, whose relative price has steadily declined. This decline has dampened the effectiveness of productivity gains in boosting material living standards. By contrast, any side-effects of reforms on income through the terms-of-trade channel are likely to be small in larger, more diversified economies.

Notes

1. This issue is elaborated in Diewert and Morrison (1986) and Kohli (2004, 2006). While the balance of imports and exports is of course a vital part of standard GDP computations, the deflators used to evaluate this item in real terms for comparisons across both time and space (countries) make certain assumptions that have conceptually weak foundations.
2. This is leaving aside the statistical discrepancy that may exist in practice between income and production approaches to compiling national accounts.
3. There is no uniform official definition of real GDI, as various deflators can be used to discount imports and exports. However, there are solid theoretical reasons to use the domestic absorption price index to deflate both import and export values (see Kohli, 2004)

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