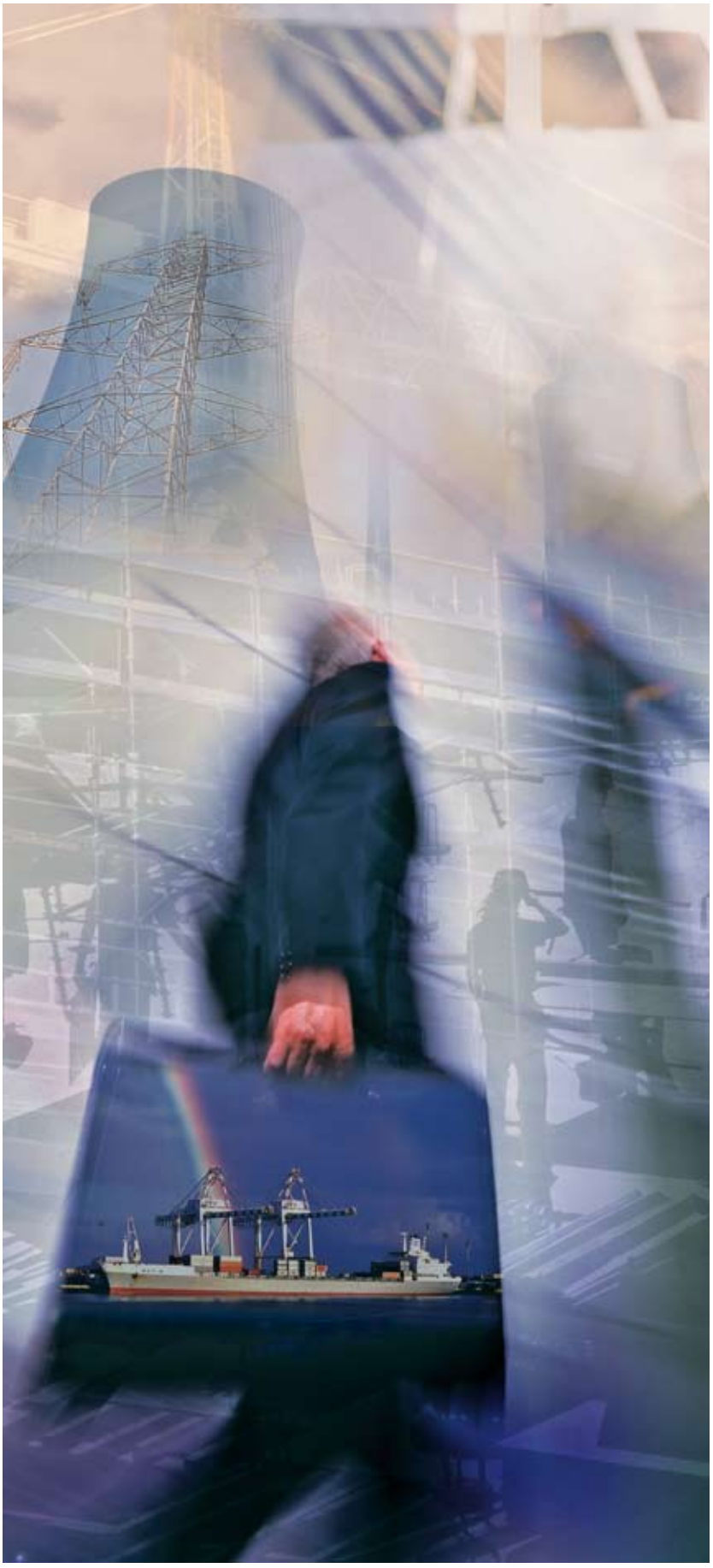

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The Economic Society of Australia warmly welcomes you to the Gold Coast, Queensland, Australia for the 37th Australian Conference of Economists.

The Society was formed 83 years ago in 1925. At the time, the Society was opposed to declarations of policy and instead focused on open discussions and encouraging economic debate. Nothing has changed today, with the Society and the conference being at the forefront of encouraging debate.

This year we have a large number of papers dealing with Infrastructure, Central Banking and Trade.

Matters of the greatest global importance invariably boil down to be economic problems. Recent times have seen an explosion of infrastructure spending, after world-wide population growth has seen demand outpace aging supply. The world has become more globalised than at any time since World War I but the benefits of this (and the impact on our climate) has been questioned by some.

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We are also very pleased to see a wide selection of papers ranging from applied economics to welfare economics. An A – Z of economics (well, almost).

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Gauging Economic Performance under Changing Terms of Trade: Real Gross Domestic Income or Real Gross Domestic Product ?

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November 2007

Gauging Economic Performance under Changing Terms of Trade: Real Gross Domestic Income or Real Gross Domestic Product?

Abstract

The paper presents a simple theoretical case for the superiority of Real Gross Domestic Income to Gross Domestic Product. It is shown that, in a multi-period version of the familiar neoclassical model of a small open economy, a temporary improvement in its terms of trade will increase welfare and RGDI, and produce excess an excess of exports over imports; but will decrease real GDP, on account of it creating an constant prices excess of *imports* over exports.

JEL codes

E01 F11

Keywords

National income

1. Introduction

Australia's terms of trade have risen by 40 percent since 2002, to reach their highest level in 50 years. What is the significance of this sudden surge? How is its impact best measured? To answer that question it is advisable to review the efficacy of standard measures of macroeconomic performance.

Gross Domestic Product (or one its variants) has been the pre-eminent measure of macroeconomic performance for over sixty years. Yet many other measures of performance have been mooted, and some enjoy considerable support of statistical authorities. In 2001 the Australian Bureau of Statistics publicly called attention to several broader measures of 'progress' that were being supplied by the Australian System of National Accounts. Among these was Real Gross Domestic Income (RGDI). The demerit of GDP in comparison with RGDI, the Bureau contended, was that 'in periods of strong increases (decreases) in the terms of trade, focusing solely on GDP would not take into account the affect of increased (decreased) income available to Australian residents'(see ABS 2004 and 2006). RGDI, in welcome contrast, does take into account changes in income from changes in terms of trade. Since 2001 data on RGDI has been regularly and prominently supplied as part of the Bureau's quarterly release of national accounts.

This ABS's copious and timely provision of RGDI data obvious assumes a particular significance in the light of the recent sudden improvement in Australia's terms of trade. It is on account of that increase that RGDI has grown more strongly than GDP in each year since the beginning of the present decade; and that the cumulative difference between the growth in the two aggregates since the beginning of the decade has now passed 10 percent.

Table 1: Australian GDP and RGDI

Growth over Previous Year, per cent

	GDP	*RGDI*
2000/1	0.9	1.2
2001/2	5.0	5.4
2002/3	2.2	2.7
2003/4	4.0	6.1
2004/5	3.5	5.6
2005/6	2.3	3.7
2006/7	4.6	6.0
June 2007 over June 2001	24.7	34.9

Nevertheless, GDP remains the overwhelming focus of the reportage and analysis of macroeconomic performance.

This paper appraises the potential contribution of RGDI to the measurement and diagnosis of macroeconomic conditions. It investigates if, and how, RGDI might be more informative, and more explanatory, of variables of interest: including economic welfare, consumption, investment and employment.

The paper's method is theoretical. It reviews the conceptualisation of GDP and RGDI in the context of the basic neoclassical model of a small open economy. It then identifies what this model implies will be the impact of a change in the terms of trade for the magnitude of RGDI, GDP and other large aggregates. This analysis shows how movements in RGDI captures movements in welfare better than GDP, and demonstrates that GDP responds in non-intuitive manner to favourable Terms of Trade shocks.

2. The genesis of the GDP and RGDI concepts.

The conceptual framework of Gross Domestic Product was developed in the early 1940s as part of the application of Keynesian revolution to economic management (Meade and Stone, 1941).[1]

[1] Meade and Stone did not actually use the term 'gross national product'. The first usage of this phrase in the modern sense that the present author has noticed is in

GDP was not, however, the first measure of aggregate economic performance to be implemented. Measures of 'National Income' had been constructed, and executed, well before the Keynesian revolution. Indeed, the earliest reference to 'national income' is found in 1676 in William Petty's *Political Arithmetic*.

This 'early' appearance of National Income is not surprising. Income is a familiar concept, to economist and non-economist alike. It does not require much theoretical apparatus to ask 'what would total income of all persons in the economy amount to?' Thus the fairly elaborate provision of 'national income' estimates prior to the Keynesian Revolution in the United Kingdom (Bowley and Stamp 1927), the United States, France, Germany, Spain, Japan and Canada (see Sutcliffe 1926 for details). Australia, too, had as early as 1926 a series of reputable estimates of national income from 1911 to 1924/25 (Sutcliffe 1926).

The significance of the Keynesian revolution on the infant science of national accounting was to shift attention way from aggregate income, and towards aggregate *spending*, to which it attached great explanatory significance. And the seeming beauty of GDP formulation, as developed by Meade and Stone (1941), is that it united in single concept- Gross Domestic Product - aggregate expenditure and aggregate income; as GDP can, of course, be identically constructed as the sum of factor incomes (the income method), or as the sum of expenditures net of imports (the expenditure method). Thus the GDP concept happily brought together the somewhat older, and more intuitive notion, of 'national income', with the newer Keynesian emphasis on 'aggregate demand'.

Not surprisingly, the conceptualisation of GDP was congenial to the Keynesian vision of economy as laid out in the *General Theory*: a closed economy; with no inflation, and just one good. The fitness of the Meade and Stone GDP concept therefore rested upon the assumptions of the time and context in which it was formulated. And the subsequent sixty years saw developments of conceptualisation of GDP, and some pressure on the original union it made of income and product.

Musgrave (1942). Warburton (1934) uses 'gross national product' in 1934, but uses it to refer to his estimate of what would now be termed Gross National Expenditure.

One soon-to-be-felt challenge to the usefulness to the GDP concept lay in inflation, that became a policy problem with the outbreak of the Korean War. 'Constant price estimates', from the expenditure side, were a solution, and in 1951, when prices jumped by 7.9 percent, the US Bureau of Economic Analysis first introduced them. But in a multi-good world this solution spelt a degree of loss in the happy identity of income and product.[2]

A more serious difficulty lay in the very constancy of prices that 'constant price GDP' assumed, and became palpable in the 1970s, with its massive changes in the relative prices of commodities and fuel. Real GDP, by its assumption of constant prices, was necessarily was missing out one of the very things that mattered; the perfectly 'real' change in the income of a national economy on account of the changed buying power of its exports in terms of imports. It was time for an income concept to be revived. In 1981 the BEA began to publish estimates of RGDI, that they called "command-basis GDP". [3]

Thus the emergence of RGDI might be seen in general terms as one part of a continuing process of adaptation of a conceptual framework of the 1940s to shifting circumstances. In more particular terms, it might be see as an attempt of an older income concept to disencumber itself of the Keynesian embrace.

But how successful an adaptation to circumstances is RGDI?

3. The Terms of Trade, GDP and Real Gross Domestic Income: a Theoretical Treatment

This section rehearses the conceptualisation of GDP and RGDI within a canonical neoclassical model of international trade model. It then investigates what this canonical

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[2] 'Real GDP', as measured by constant prices, will not, flukes apart, coincide with 'real income' as it is commonly understood: say, nominal income deflated by a Laspeyre's index. Constant price GDO will exactly coincide if there are no changes in relative prices, or the purchases of all goods increase at the same rate.

[3] The measure had been canvassed in 1967 by E.F. Denison, *Why Growth Rates Differ*, p.30. Its empirical divergences from GDP have recently been investigated by Kohli (2006, 2007).

model will imply will be the impact of changes in the terms of trade on RGDI and GDP (and other macro aggregates).

A Standard Model of International Trade

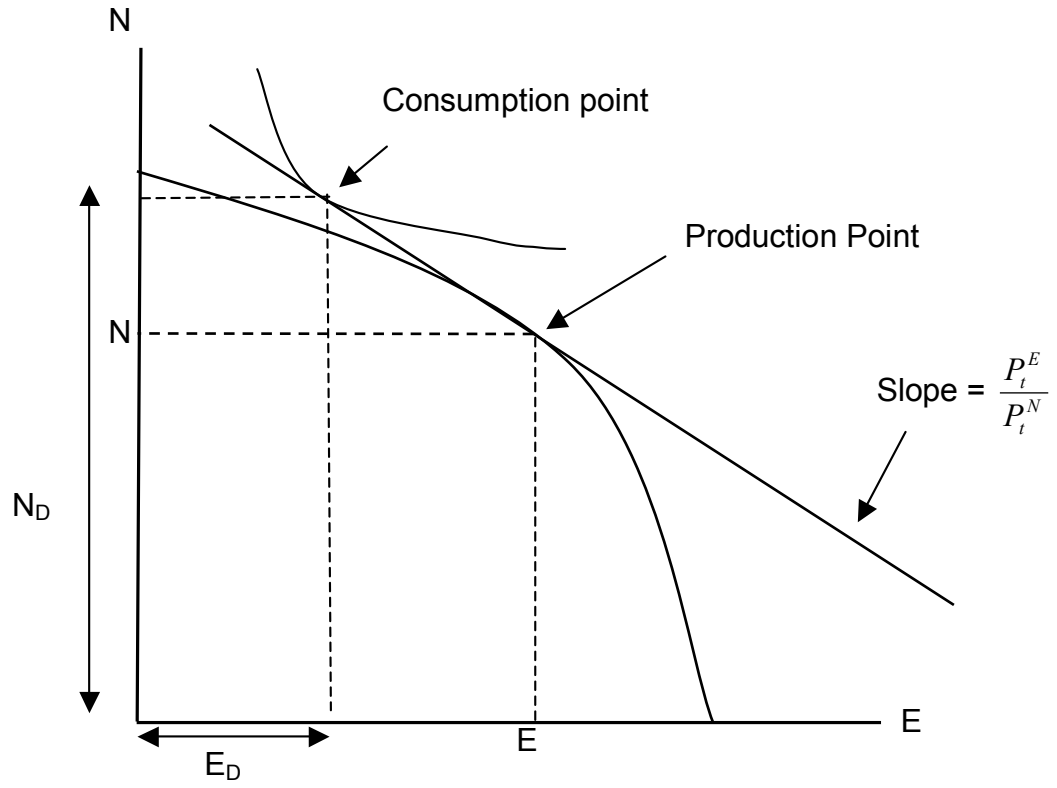
Consider a model in which two goods are consumed, produced and traded. Production of the 'exportable' is denoted E, and production of the 'importable' N. There is a trade-off in the production of the two, reflecting the presence of one or more intersectorally mobile factors. All activity takes place in a single period.

Utility is derived from consumption of N, N^D, and consumption of E, E^D. We assume preferences are identical and homothetic, implying that there exist combinations of N^D and E^D which yield the same 'Welfare Potential'; that is to say, the same utility trade-off between members of the economy. These combinations of N^D and E^D can be represented by a 'Welfare Curve', the slope of which at any point will equal the marginal rate of substitution at that point.

Finally, prices are given exogenously by the world market, P_t^N and P_t^D

The familiar equilibrium of this model is represented in Figure 1.

Figure 1: Equilibrium in a Canonical Model of International Trade



Where are the familiar aggregates of national accounting in the model; C, X, M, GDP? Nowhere, explictly. None of these aggregates have been used in articulating the model so far. Yet the model has implications for all.

The definition and representation of GDP

GDP, of course, measures the value of aggregate production of goods and services. In order to abstract from purely nominal changes in prices, GDP is constructed using prices that prevailed in some base period, period B. Thus, in terms of the model above, GDP in period t, at period B prices, and as computed by the expenditure method, is defined as,

$$GDP_t \int \; p_B^E E_t^D + p_B^N N_t^D + p_B^E [E_t - E_t^D] - p_B^N [N_t^D - N_t]$$

We may always choose units of measurement so that

$$p_B^N = p_B^E = 1$$

Thus, GDP at period B prices, as computed by the expenditure method, and after dropping the t subscripts as understood, may be expressed as,

$$GDP \int E^D + N^D + [E - E^D] - [N^D - N]$$

We can also identify other standard national income aggregates, (real consumption, real exports and real imports) with the categories of the model,

$$X \int E - E^D$$
$$M \int N^D - N$$
$$C \int E^D + N^D$$

These identifications when combined with the expression for GDP above yields

$$GDP = C + X - M$$

This obviously conforms to the familiar national income identity, given that there is no investment in the model.

Diagrammatic Measures

X and M are very easily represented in terms of Figure 1, but the representation GDP requires a little more effort. To obtain a diagrammatic representation of GDP it proves helpful to note that we could have equivalently computed GDP in period t, at period B prices, by means of the 'output method';

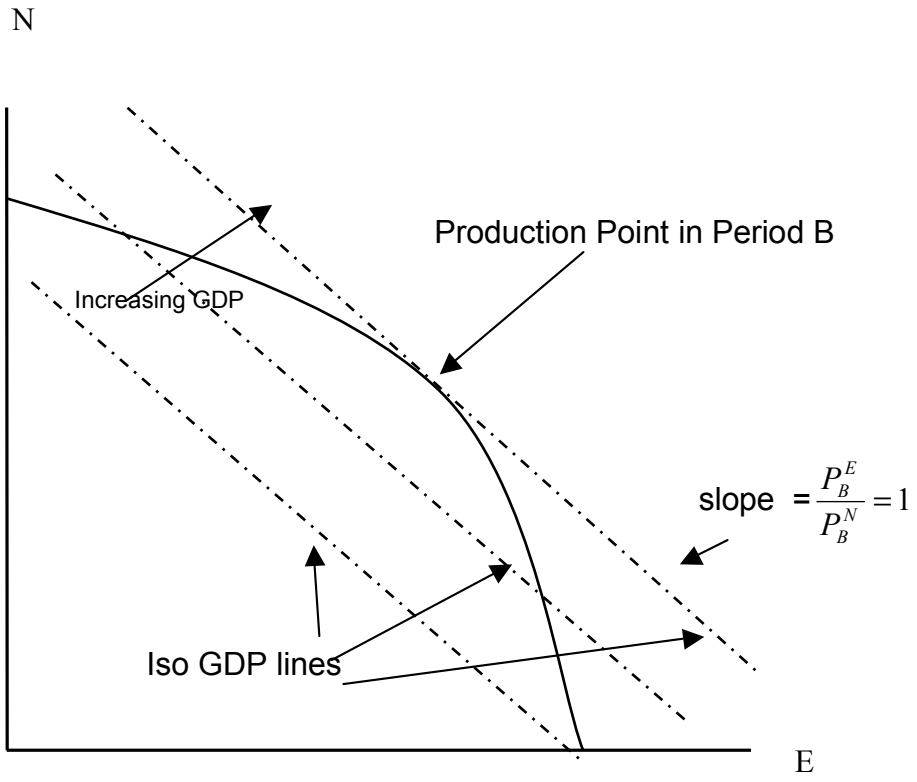
$$GDP_t \int p_B^E E_t + p_B^N N_t$$

Letting $p_B^N = p_B^E = 1$, then GDP in period t at period B prices, as computed by the output method, and after dropping the t subscripts as understood, is

$$GDP \int E + N$$

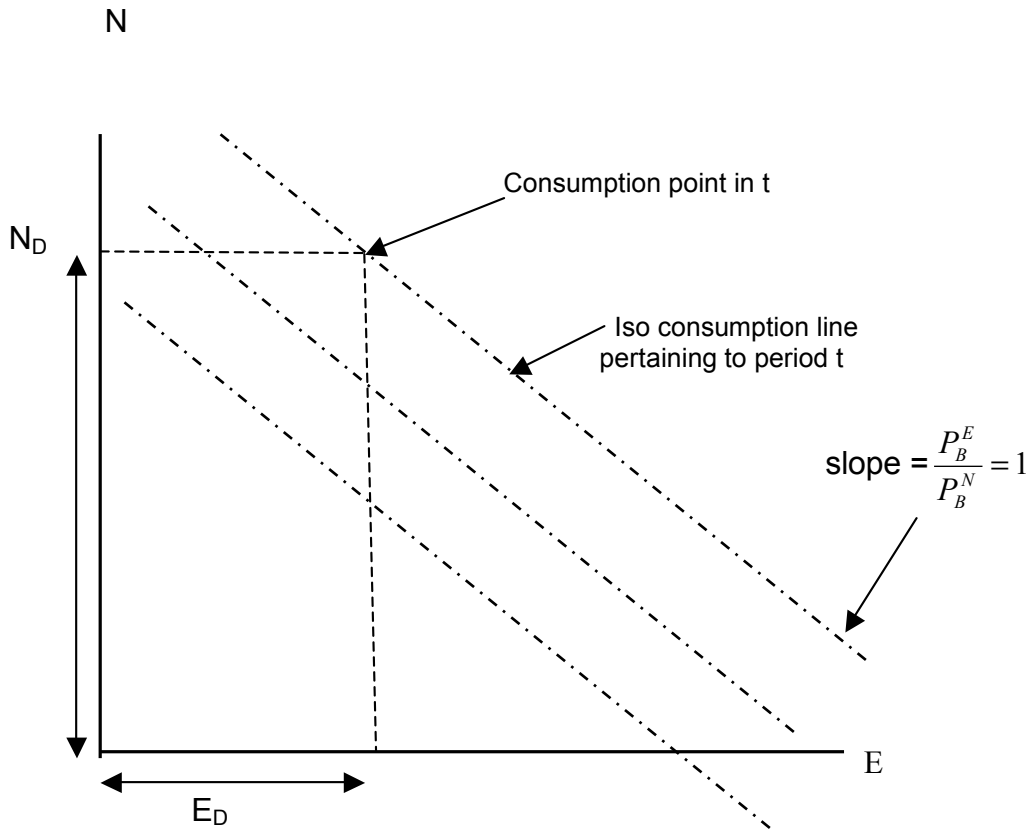
Thus knowledge of the production point in period B allows us to construct linear combinations of N and E all of which yield some magnitude of GDP in any period, as measured at period B prices. These combinations constitute an 'iso GDP' line. Clearly, a 'family' of these 'iso GDP' lines exist, with a movement to a 'north east' iso GDP line constituting an increase in GDP.

Figure 2: Iso GDP Lines



By the same method we can construct 'iso consumption' line; the combinations of N^D and E^D all of which yield some magnitude of C. Any such line will have the same slope as an iso GDP line.

Figure 3 : Iso Consumption Lines



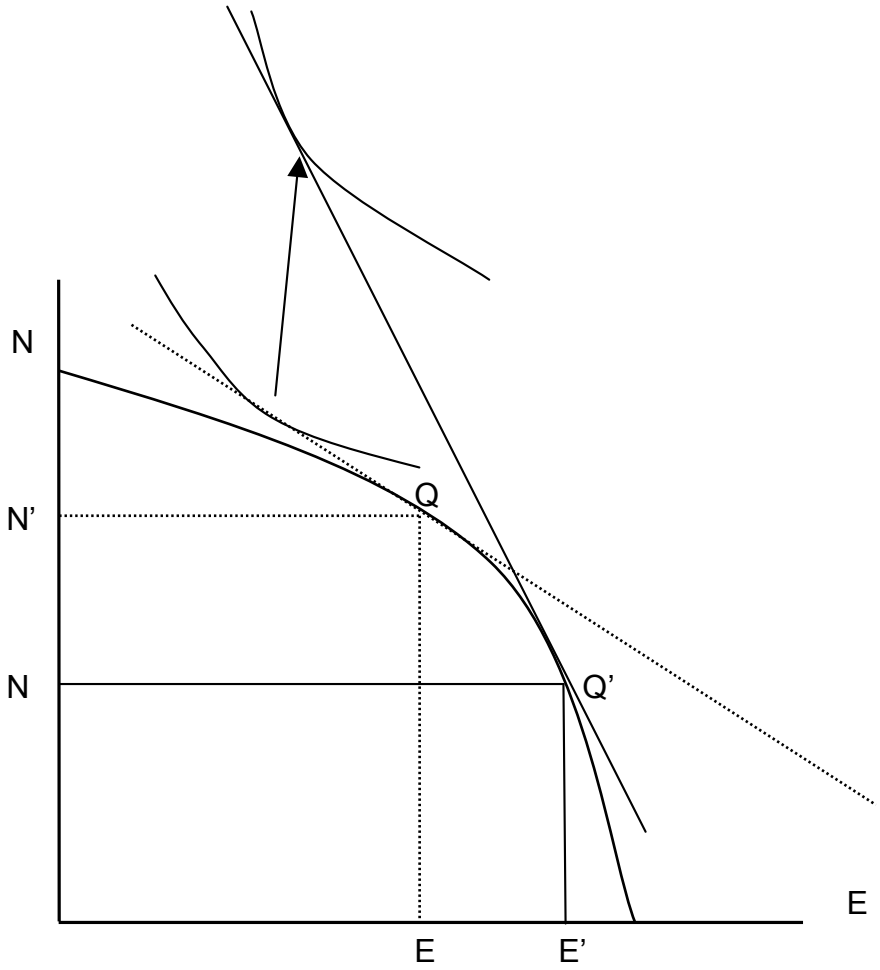
Thus, given N^D and E^D in any two periods, we can infer the relative size of C in the two periods.

The comparative-statics of an increase in the terms of trade

We now turn to the impact that a change in the terms of trade will have on GDP and RGDI.

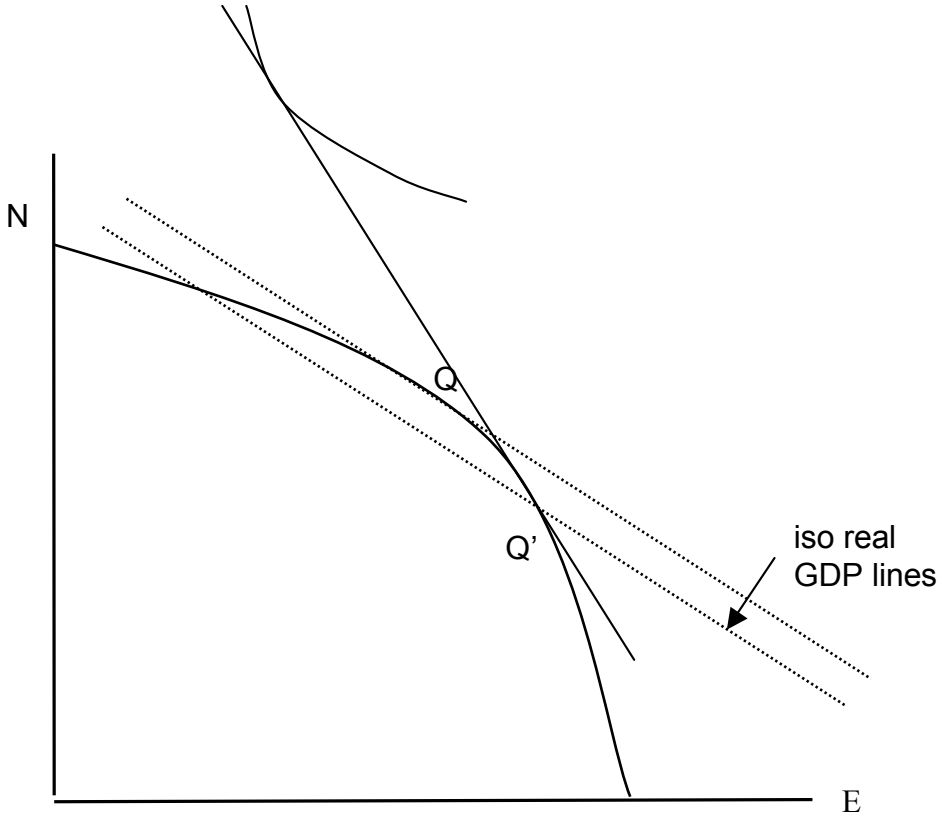
It is not difficult to see (Figure 4) that an increase in the value of the Exportable in terms of the Importable will increase Welfare Potential. It will also increase E and reduce N. It will increase M. But it will have an ambiguous impact on X; the substitution effect (in both supply and demand decisions) is favourable to higher exports of the exportable, but the income effect of the improved terms of trade encourages higher home purchases of the exportable, that tends to diminish exports of the exportable.

Figure 4: The Impact of an Improvement in the Terms of Trade



What will happen to measured GDP? Figure 5 brings out that the reallocation of production shifts the economy on to a *lower* iso GDP line.

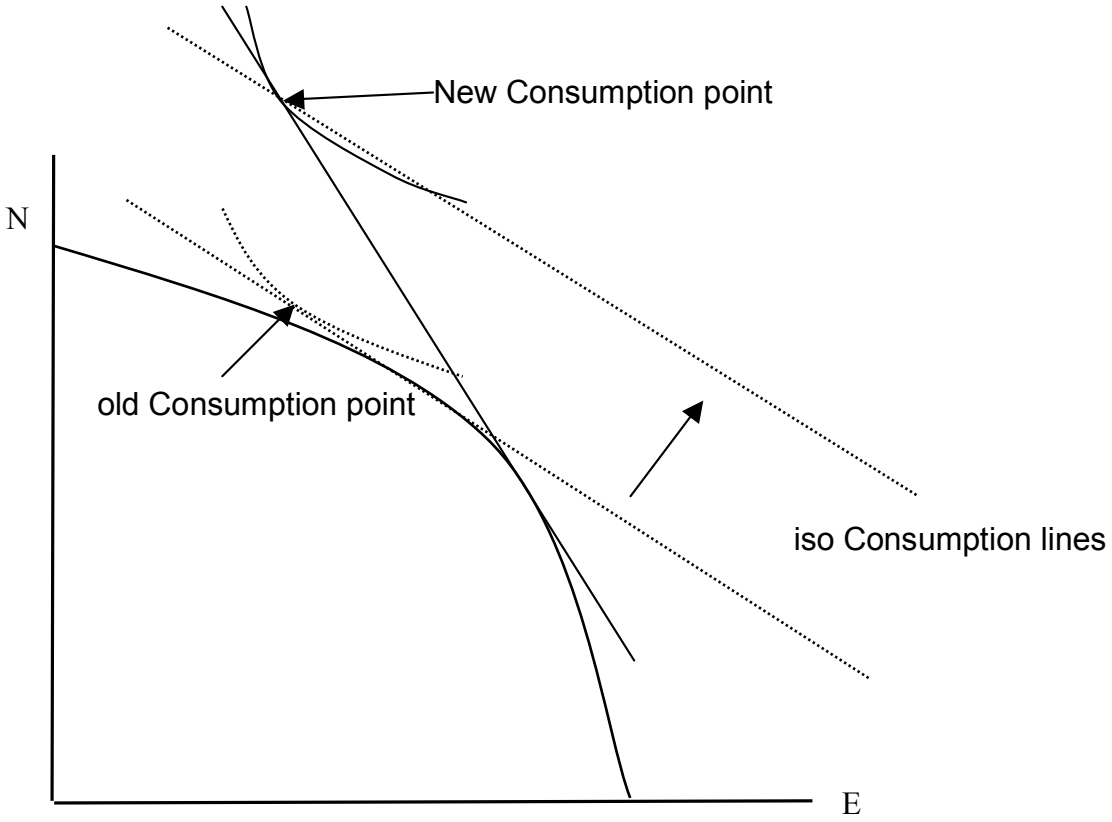
Figure 5: GDP falls with an increase in the Terms of Trade



Conclusion: GDP *falls*. 'Multifactor productivity' will also be recorded as falling.

C, however, has increased: it is not difficult to see that the new consumption bundle has shifted the economy onto a higher 'iso consumption line: C has increased.

Figure 6: Consumption rises with an increase in the Terms of Trade



As a further inference, we may deduce from GDP = C + X-N, that X –N, the real trade balance has decreased.[4] Moreover, since X-N had a zero value it in the base period, we may conclude that an improvement in the terms of trade must reduce X-N to a negative magnitude; a trade deficit.

Thus an improvement in the terms of trade increases welfare, but reduces GDP. It reduces GDP account the emergence of real trade deficit, even though in the model trade is always balanced. You might say an imaginary deterioration in the trade balance that drags on measured GDP. GDP, in these circumstances, does behave rather oddly

[4] Indeed, we can infer that X-N has gone down by more than C has risen.

The definition of RGDI

A measure of macroeconomic activity that does not have this peculiar result is Real Gross Domestic Income.

RGDI is computed by taking the expenditure method of compute GDP, dropping the export volume term, and replacing it with *the volume of imports that could be currently purchased by the current value of exports*.

$$RGDI_t \int p_B^E E_t^D + p_B^N N_t^D + p_B^E[\frac{p_t^E[E_t - E_t^D]}{p_t^N}] - p_B^N[N_t^D - N_t]$$

$$= E^D + N^D + \frac{p^E}{p^N}[E - E^D] - [N^D - N\ ]$$

$$= N + \frac{p^E}{p^N}[E - E^D] + E^D$$

Note that $N + \frac{p^E}{p^N}[E - E^D]$ is the total supply of the importable that nation has, either from domestic production N, or imports $\frac{p^E}{p^N}[E - E^D]$. E^D is obviously the demand for the importable. Thus, RGDI may be expressed verbally as the 'the supply of the importable plus the demand of the exportable'. [5]

[5] In the present model RGDI can also be very simply related to another aggregate. It is not difficult to ascertain that,

$$RGDI \int C + \frac{p^E}{p^N}X - M$$

But as in the present model, $p^E X = p^N N$, we may write,

$$RGDI = C$$

The diagrammatic representation of RGDI

It proves helpful to appreciate that an increase in RGDI can be inferred using a diagrammatic construction deployed in Figure 7. As $RGDI = E^D + N + \frac{p^E}{p^N}[E - E^D]$, we can locate in E: N space E^D and $N + \frac{p^E}{p^N}[E - E^D]$, and construct linear combinations of E^D and $N + \frac{p^E}{p^N}[E - E^D]$, which yield some magnitude of RGDI. These combinations constitute an 'iso RGDI' line. Evidently, the after-the-shock combination of E^D and $N + \frac{p^E}{p^N}[E - E^D]$is associated with a higher 'iso RGDI' line than the before-the-shock combination of E^D and $N + \frac{p^E}{p^N}[E - E^D]$.

As we have already inferred that C has increased with the improvement in the terms of trade, we may further conclude that RGDI has increased with the improvement in the terms of trade. That is, RGDI has *increased* with the increase in welfare (which is reassuring).

Figure 7: RGDI increases with an increase in the Terms of Trade

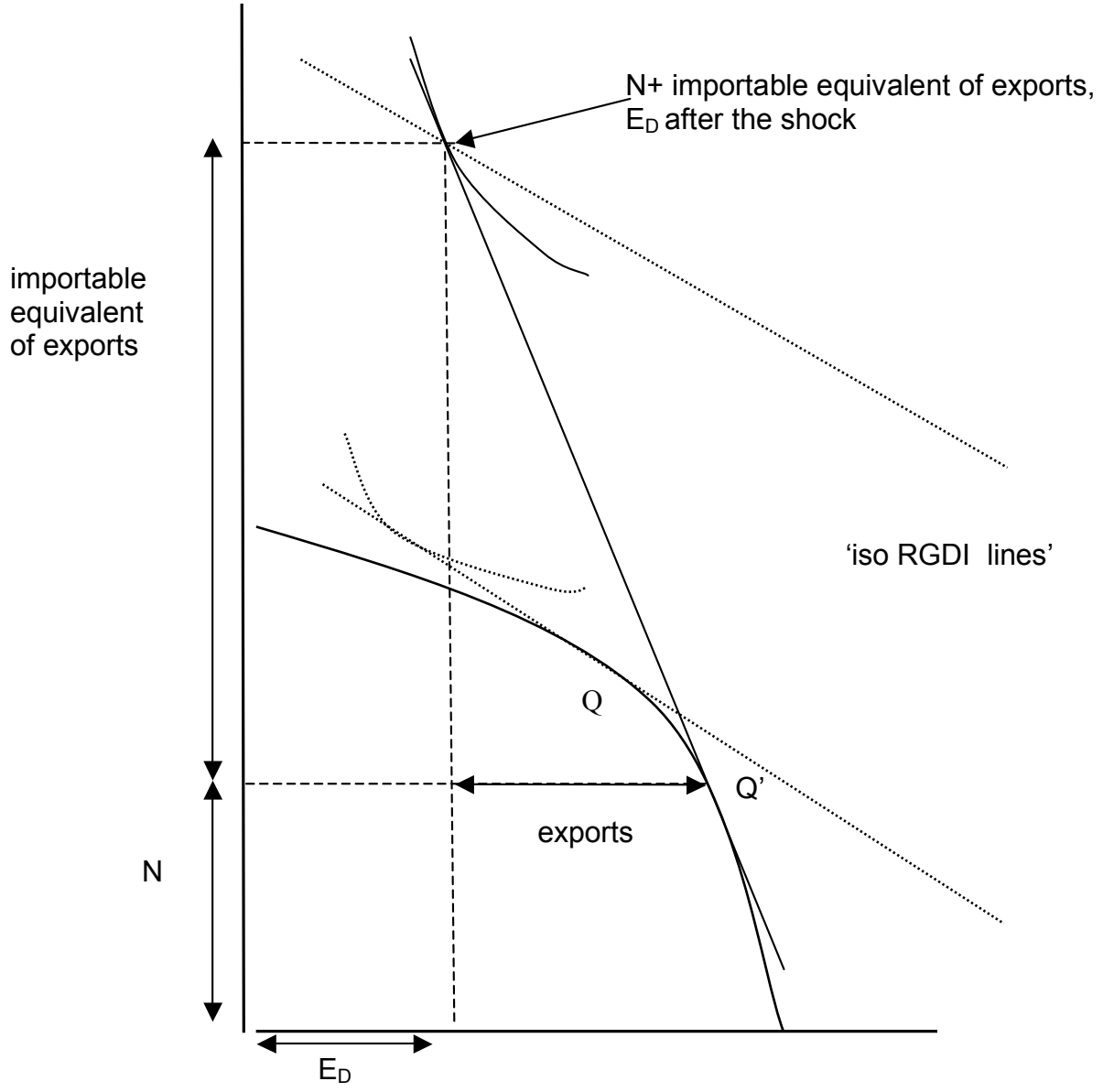


Table 2 summarises our conclusions.

Table 2: The Impact of an Improvement in Terms of Trade
in a Standard Model of International Trade

Welfare Potential	+
C	+
I	0
E	+
N	-
X	?
M	+
GDP	-
multifactor productivity	-
RGDI	+

4. A Two Good, Multi-Period Extension

The 'canonical model' has the disadvantage that the current value of exports always equals the current value of imports; the balance of trade is zero.

How does allowance for a current account deficit (or surplus) change, if at all, our previous conclusions? This sub-section shows that allowing for trade surpluses or deficits only increases the oddness of GDP in the face of terms of trade shocks.

We suppose now the economy lasts many periods, rather than one. We continue to suppose that physical investment is zero, but we now suppose there exists a global bond market with which home can borrow and lend, at a fixed rate r.[6]

The production decision in this reformulated model remains the same as before. But the access to bond markets changes the response to changes in the terms of trade, as smoothing consumption over time is both possible and desired.[7]

Consider, first, a purely temporary, this-period-only, increase in the price of the exportable. The production of E increases, and the production N decreases, just as before. The ratio of N^D to E^D rises, just as before. But the scale of the adjustment in purchases has changed. In the reformulated model not all the improvement in buying opportunities is devoted to the current period. Owing to the smoothing of consumption, part of the increase in buying power is transferred to the future to fund future spending; and that transfer is effected by establishing credit balances with overseas importers of home exports (ie exports are sold partly on credit).

Thus in the multi-period model, a temporary improvement in the terms of trade produces a trade surplus. For that reason C is no longer synonymous with RGDI; the two magnitudes diverge. C is not as large as in the one-period model, in account of consumption smoothing. RGDI is *larger* than in the one period model, as Figure 8 brings out. This on account of the fact that, compared to the one period model, the increase in the terms of trade yields a smaller increase in the home consumption of the exportables, and so larger exports. As it is exports that is evaluated according to the

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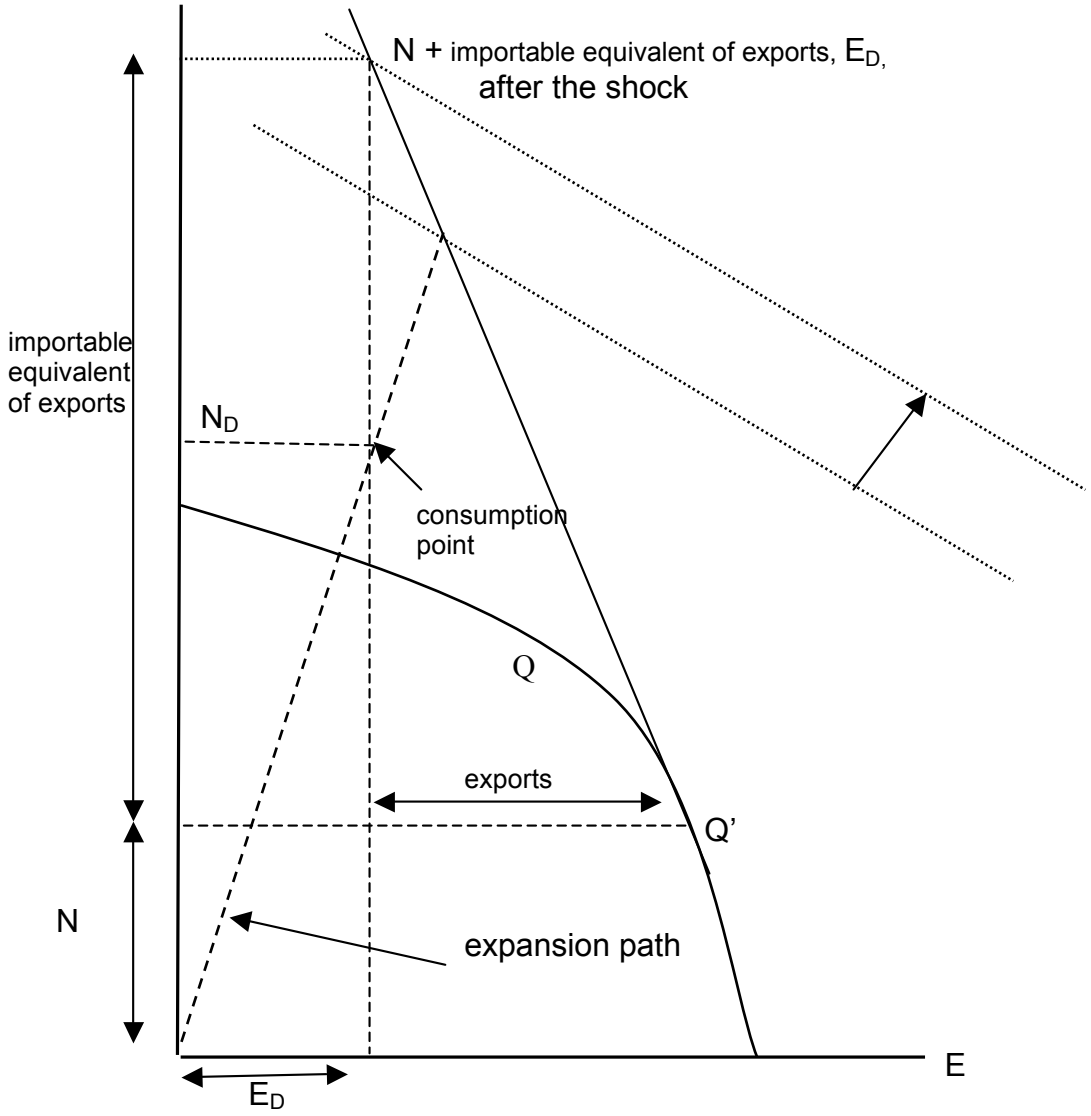
[6] The rate can be understood as a real rate in terms of the importable. We will also suppose the real interest rate converges on the home country's rate of time preference in the long run.

[7] The uncoupling of expenditure in a period from income in a period is manifested by the replacement of economy's 'income equals expenditure' budget constraint, by one that consolidates its budget constraints in all periods, so that the present value of expenditure equals the present value of all income. If, to save on subscripts, we let the current period be period zero, then this consolidated budget constraint is,

$$\ldots+\frac{P_2^E E_2^D}{[1+r]^2}+\frac{P_1^N N_1^D}{1+r}+\frac{P_1^E E_1^D}{1+r}+P_0^N N^D+P_0^E E^D=P_0^E E+P_0^N N+\frac{P_1^E E_1}{1+r}+\frac{P_1^N N_1}{1+r}+\ldots$$

increased terms of trade, the impact on RGDI of the smaller magnitude of E^D in the multi-period model is more than offset by the impact of the larger magnitude of exports.

Figure 8: A temporary an increase in the Terms of Trade in a Multiperiod Model



GDP, however, still diminishes, just as it did one period model, by precisely the same logic, and by precisely the same amount. Further, as C increases, the fall in GDP implies a decrease in X-M (just as it did in the one period model). Thus an increase in the terms of trade generates a trade deficit at constant prices, but a trade surplus at current prices. It is this 'real' trade deficit – which does not 'really' exist - that drags down GDP.

5. Conclusion

The paper has presented a simple theoretical case for the superiority of Real Gross Domestic Income to Gross Domestic Product. It has shown that in a multi-period version of the familiar neoclassical model two good price-taking economy, that a temporary improvement in its terms of trade will increase welfare and RGDI, and produce a trade surplus; but will decrease real GDP on account of it creating an a trade deficit in constant price terms.

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