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REGIONAL TRADING ARRANGEMENTS AND INTRA-INDUSTRY TRADE: THE CASE OF ANZCERTA

by

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ABSTRACT

Empirical work on intra-industry trade (IIT) is almost 30 years old. From the earliest analyses of IIT, the phenomenon has been associated with Regional Trading Agreements (RTAs). An important motivation for this research is associated with the issue of adjustment costs; if most of the growth in trade resulting from the RTA is attributable to IIT, then the resource re-allocation costs in the short to medium term are likely to be lower. This is because IIT does not require inter-industry factor movements. In attempting to determine whether RTAs are associated with increases in IIT, previous researchers have looked at two questions: (i) whether IIT has increased following the formation of the RTA, and (ii) whether IIT is more important in intra versus extra RTA trade. To answer the first question, researchers have used movements in the value of the Grubel and Lloyd (1975, GL) index over time, while the second has been dealt with by comparing the value of the GL index for intra versus extra RTA trade. Employing the GL index in these ways to answer these questions can lead to error. In this paper, we develop a new methodology for analysing both of these questions which overcomes the problems associated with using the GL index. First, we derive a formula which decomposes the growth in total trade (TT) into the contributions of growth in IIT and net trade (NT). Second, we show how to measure the contributions of intra and extra RTA trade to the growth in a country's total multilateral IIT and NT. The focus of our study is on the effects of the Australia-New Zealand Closer Economic Relations Trading Agreement (ANZCERTA) on Australian and New Zealand trade. All our formulas are computed with data for 130 Australian and New Zealand manufacturing industries defined at the 3-digit level of the Standard International Trade Classification (SITC) for the periods 1981 to 1986 and 1986 to 1991.

Keywords: intra-industry trade, regional trading agreements, adjustment costs.

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Regional Trading Agreements and Intra-Industry Trade: The Case of the ANZCERTA[1]

by

Jayant Menon and *Peter B. Dixon*

1. Introduction

Empirical work on intra-industry trade (IIT) is almost 30 years old. From the earliest analyses of IIT, the phenomenon has been associated with Regional Trading Agreements (RTAs). In fact, these early studies of IIT were by-products of studies on the trade effects of European integration (see Balassa, 1966; Grubel and Lloyd, 1975). Since RTAs are usually designed to promote intra-regional trade, interest has focussed on the role of IIT in this trade expansion because of its implications for adjustment costs. If most of the growth in trade is attributable to IIT, then the resource re-allocation costs in the short to medium term are likely to be lower (see Harris and Cox, 1984). This is because IIT does not require inter-industry factor movements. Whereas trade expansion through net trade (NT) requires factor transfer from import-competing industries to export-oriented industries, trade expansion through IIT requires only specialisation within industries. Furthermore, as Krugman (1981) has shown, it is possible for all factors to gain from trade in an IIT setting, thus alleviating adjustment pressures. In this context, Caves (1981) suggests that protectionist pressures are unlikely to grow in proportion to the degree of import competition, thus protecting the integrity of regional trading agreements. Governments will not be faced with as much pressure to intervene to protect employment in less competitive industries.

Do RTAs promote IIT?. In attempting to answer this question, previous studies have examined one or both of the following two issues. The first relates to the changes in IIT before and after the formation of the RTA. In addressing this issue, researchers have used movements in the value of the Grubel and Lloyd (GL, 1975) index over time to infer some pattern of the changing importance of IIT. That is, if the value of the GL index during the post-RTA period was higher than it was pre-RTA, then this

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(1) **This is a revised version of a paper presented to the 1994 NZAE Winter Conference, "New Zealand and the International Economy", held at Massey University. We are grateful to participants at this conference and those at a seminar at the Australian National University for helpful suggestions. Any remaining errors are our own.**

was taken to imply that the RTA increased IIT. The second issue examined in an attempt to determine whether RTAs promote IIT relates to the relative importance of IIT in intra and extra RTA trade. The method employed here is to compare the value of the GL index for intra and extra RTA trade (sometimes also tracing the evolution of each over time). If the value of the GL index is higher for intra RTA trade than it is for extra RTA trade, the inference is then drawn that RTAs increase IIT because intra RTA trade contributes more to a country's total multilateral IIT than extra RTA trade. Examples of studies that have employed one or both of these methods include Balassa (1966), Willmore (1974), Grubel and Lloyd (1975), Pelzman (1978), Drabek and Greenaway (1984), Bano and Lane (1987), and Globerman and Dean (1990).[2]

There are problems associated with both these methods in determining whether RTAs promote IIT, however. With respect to the first, movements in the value of the GL index over time is an inadequate measure of the changing importance of IIT. That is, it cannot answer the relevant question, which relates to the *contribution* of growth in IIT to the growth in total trade (TT). Furthermore, it may not even be indicative of changes in the importance of IIT, since the GL index can record an increase (decrease) despite IIT contributing less (more) than net trade (NT) to the growth in TT. An increase (decrease) in the GL index over time is also compatible with a decrease (increase) in IIT.

Previous studies that have computed GL indexes for intra and extra-RTA trade have ignored the relationship between them and the country's multilateral trading position or, more precisely, their relationship with the trade imbalance at the multilateral level. That is, intra and extra RTA IIT is measured independently of whether the multilateral trading position is dominated by imports or exports. Unless the intra and extra RTA trade imbalance have the same sign as the imbalance at the multilateral level, this method will lead to bias in measured IIT.[3] This bias is reflected in the fact that total multilateral IIT will not equal the sum of intra and extra RTA IIT if opposite signed imbalances exist.[4] In this instance, it is no longer the case, for example, that a lower value of the GL index for intra RTA trade as

(2) A useful survey of these studies is provided in Greenaway (1982).

(3) As mentioned earlier, some studies have compared movements in the value of GL indexes over time for intra and extra RTA trade. Not only is this method subject to bias as a result of opposite signed imbalances, but may be further complicated by the problems associated with using movements in the GL index over time to infer its changing importance.

(4) Opposite signed imbalances for intra and extra RTA trade can occur if the RTA results in significant trade diversion.

opposed to extra RTA trade can be taken to imply that intra RTA trade contributes less to a country's total multilateral IIT than extra RTA trade. In other words, in the presence of opposite signed imbalances, conclusions drawn on the basis of a comparison between GL indexes for intra and extra RTA trade might prove misleading.

In this paper, we propose a methodology which overcomes these problems. First, we derive a formula which decomposes the growth in TT into the contributions of growth in NT and IIT. This decomposition formula overcomes the problems associated with using movements in the value of the GL index over time to infer some pattern of the changing importance of IIT. With this formula, we are able to provide an explicit answer to questions such as, "How much of the growth in TT is a result of growth in IIT?". In interpreting changes in the IIT share of TT over time, previous researchers have often alluded to underlying changes in import-export performance. To clarify the roles of imports and exports, we also derive formulas that measure their growth contributions to growth in total, net and intra-industry trade.

Second, we derive formulas which measure the contributions of intra and extra RTA trade to the growth in (total multilateral) TT, NT and IIT. In deriving these growth contribution measures, we explicitly take into account the relationship between the trade imbalance at the intra and extra RTA level and that at the total multilateral level. These formulas enable us to answer questions such as, "What are the contributions of intra and extra RTA trade to the overall growth in a country's IIT?".

The focus of our study is on the effects of the Australia-New Zealand Closer Economic Relations Trading Agreement (ANZCERTA) on Australian and New Zealand trade. All our formulas are computed with data for 130 Australian and New Zealand manufacturing industries defined at the 3-digit level of the Standard International Trade Classification (SITC) for the periods 1981 to 1986 and 1986 to 1991. We consider 3 types of trade flows associated with Australia and New Zealand over these two periods: (i) bilateral or intra RTA, (ii) extra RTA, and (iii) total multilateral (i.e. the sum of (i) and (ii)).

The paper is in six parts. Section 2 provides a brief overview of the ANZCERTA, focusing on trade developments leading up to it, and the nature of its reforms. Section 3 contains the derivations of the decomposition formulas. Data issues are discussed in Section 4. Results of our study are presented in Section 5, while a final section summarises the main points.

2. The ANZCERTA: An Overview

The ANZCERTA should be viewed as the culmination of more than half a century of effort in pursuing free trade between Australia and New Zealand. The first formal trade agreement between the two countries was signed in 1922, which reduced the tariff on 129 items to the "preferred" British rate. By 1933, all tariff rates between the two countries were brought into line with British rates. The precursor to ANZCERTA, the New Zealand-Australia Free Trade Agreement (NAFTA) was signed in 1965, which extended the number of items for tariff reduction, but continued to allow quantitative restrictions. At the conclusion of the NAFTA in 1982, Australia's average tariff on New Zealand imports, when it was applied, was around 10 percent, while the New Zealand tariff on Australian imports was generally over 20 percent (see Bollard and McCormack, 1985).

The ANZCERTA was signed on 1 January 1983. Unlike NAFTA, the ANZCERTA automatically included all goods traded between the two countries unless specifically excluded. It is important in the context of bilateral trade for two main reasons: (i) it eliminates practically all impediments to trade between two of the previously most highly protected industrial countries, and (ii) next to the European Community, it is considered the most *comprehensive* trading agreement in the world. Following a review in 1988, the ANZCERTA was expanded to include provisions to (i) eliminate all export subsidies and incentives on goods traded bilaterally, with exceptions for certain sensitive industries (although some sensitive items which had previously been excluded such as steel and motor vehicles were now incorporated), (ii) waive anti-dumping actions against each other, (iii) harmonise customs procedures, business laws, quarantine arrangements and technical barriers to trade, and (iv) extend the agenda to services and to investment.[5]

(5) For a more detailed discussion of the ANZCERTA, see Globerman and Dean (1990) and Menon (1994).

3.0 Analytical Framework

3.1 Decomposition of TT Growth: Contributions of Growth in NT and IIT

Total trade (*TT*) for commodity *i* between country *j* and country (or group of countries) *k* in any year is the sum of net trade (***NT***) and intra-industry trade (***IIT***):

$$\boldsymbol{TT}_{ijk} = \boldsymbol{NT}_{ijk} + \boldsymbol{IIT}_{ijk} , \quad (1)$$

where

$$\boldsymbol{TT}_{ijk} = \boldsymbol{X}_{ijk} + \boldsymbol{M}_{ijk} , \quad (2)$$

$$\boldsymbol{NT}_{ijk} = |\boldsymbol{X}_{ijk} - \boldsymbol{M}_{ijk}| \quad (3)$$

and

$$\boldsymbol{IIT}_{ijk} = (\boldsymbol{X}_{ijk} + \boldsymbol{M}_{ijk}) - |\boldsymbol{X}_{ijk} - \boldsymbol{M}_{ijk}| . \quad (4)$$

$\boldsymbol{X}_{ijk}$ and $\boldsymbol{M}_{ijk}$ are exports to, and imports from, country (or group of countries) *k* of country *j* of commodity *i* valued in base period f.o.b. prices.

The percentage growth in total trade between countries *j* and *k* of commodity *i* ($\boldsymbol{tt}_{ijk}$) over any period is given by[6]:

$$\boldsymbol{tt}_{ijk} = \mathbf{C}\boldsymbol{nt}_{ijk} + \mathbf{C}\boldsymbol{iit}_{ijk} , \quad (5)$$

where

$$\mathbf{C}\boldsymbol{nt}_{ijk} = (1 - \mathbf{GL}_{ijk})\, \boldsymbol{nt}_{ijk} , \quad (6)$$

$$\mathbf{C}\boldsymbol{iit}_{ijk} = \mathbf{GL}_{ijk}\, \boldsymbol{iit}_{ijk} , \quad (7)$$

$$\mathbf{GL}_{ijk} = \boldsymbol{ITT}_{ijk} / \boldsymbol{TT}_{ijk} \quad (8)$$

and $\boldsymbol{nt}_{ijk}$ and $\boldsymbol{iit}_{ijk}$ are the percentage changes over the period in $\boldsymbol{NT}_{ijk}$ and $\boldsymbol{IIT}_{ijk}$. Note that

$$\mathbf{GL}_{ijk} = 1 - \{|\boldsymbol{X}_{ijk} - \boldsymbol{M}_{ijk}| / (\boldsymbol{X}_{ijk} + \boldsymbol{M}_{ijk})\} ,$$

which is the Grubel-Lloyd index of intra-industry trade at the beginning of the period.

In our study of Australian and New Zealand trade reported in Section 5, $j = A$ or N, where A = Australia and N = New Zealand. $k = A$, N, W, or R, where W = world or total multilateral and R = rest of world (i.e. either excluding Australia (*NR*) or New Zealand (*AR*)). That is, we consider bilateral or intra-RTA trade

(6) The decomposition formulas presented in Sections 3.1 and 3.2 are based on Menon and Dixon (1994).

between Australia and New Zealand, as well as each country's total multilateral and extra-RTA trade.

In section 5, we find that growth rates in NT are largely uncorrelated with growth rates in IIT.[7] Under the assumption that nt_{ijk} is determined independently of iit_{ijk}, $\mathbf{C}nt_{ijk}$ is the contribution to growth in total trade of growth in net trade, while $\mathbf{C}iit_{ijk}$ is the contribution of growth in intra-industry trade.

As mentioned in the introduction, a common practice has been to use movements over a period in GL indices as indicators of the importance of growth in IIT. $\mathbf{GL}_{ijk}$ will increase over a period whenever $iit_{ijk} > nt_{ijk}$. However, even under this condition, iit_{ijk} may make a relatively minor contribution to growth in total trade of product i. Consequently, in this study we prefer to use our contribution measures ($\mathbf{C}nt_{ijk}$ and $\mathbf{C}iit_{ijk}$). These take account not only of growth rates in intra-industry and net trade, but also of their shares in total trade. More formally:

$$iit_{ijk} > nt_{ijk} \text{ implies } \mathbf{GL}_{ijk} \text{ is increasing,}$$

$$\text{but if } \mathbf{GL}_{ijk} < nt_{ijk} / (nt_{ijk} + iit_{ijk}), \tag{9}$$

$$\text{and } nt_{ijk} + iit_{ijk} > 0, \tag{10}$$

$$\text{then } \mathbf{C}iit_{ijk} < \mathbf{C}nt_{ijk}.[8]$$

$$\text{Similarly, } nt_{ijk} > iit_{ijk} \text{ implies that } \mathbf{GL}_{ijk} \text{ is decreasing,}$$

$$\text{but if } \mathbf{GL}_{ijk} > nt_{ijk} / (nt_{ijk} + iit_{ijk}) \tag{9a}$$

$$\text{and } nt_{ijk} + iit_{ijk} > 0, \tag{10a}$$

$$\text{then } \mathbf{C}nt_{ijk} < \mathbf{C}iit_{ijk}.$$

These propositions show that movements in the GL index might prove misleading when used to infer the importance of growth in IIT.

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(7) For Australia-New Zealand trade, the correlation coefficient between growth in NT and IIT over the period 1981 to 1986 is -0.028, and -0.039 for the period 1986 to 1991. This finding is consistent with theory, since the factors that determine NT are different from those that drive IIT (see, for instance, Helpman and Krugman, 1985).

(8) Equations (9) and (10) imply that:

$$\mathbf{GL}_i\, nt_i + \mathbf{GL}_i\, iit_i < nt_i,$$

$$\text{i.e. } -(1 - \mathbf{GL}_i)nt_i + \mathbf{GL}_i\, iit_i < 0,$$

$$\text{i.e. } \mathbf{C}iit_i < \mathbf{C}nt_i.$$

3.2 Decomposition of Growth in TT, NT and IIT: Contributions of Growth in Imports and Exports

In this subsection, we decompose growth in TT, NT and IIT into the contributions of imports and exports. Starting from equation (2), we find that

$$tt_{ijk} = \mathbf{C}mtt_{ijk} + \mathbf{C}xtt_{ijk} , \quad (11)$$

where

$$\mathbf{C}mtt_{ijk} = (M_{ijk} / TT_{ijk})\, m_{ijk} , \quad (12)$$

$$\mathbf{C}xtt_{ijk} = (X_{ijk} / TT_{ijk})\, x_{ijk} \quad (13)$$

and m_{ijk} and x_{ijk} are growth rates over the period in M_{ijk} and X_{ijk}. Assuming independent determination of m_{ijk} and x_{ijk}, $\mathbf{C}mtt_{ijk}$ and $\mathbf{C}xtt_{ijk}$ are the contributions of import and export growth to growth in total trade in good i.[9]

Next we derive the contributions of import and export growth to the growth in NT_{ijk} and IIT_{ijk}. We find from equations (3) and (4) that

$$nt_{ijk} = \mathbf{C}mnt_{ijk} + \mathbf{C}xnt_{ijk} \quad (14)$$

and

$$iit_{ijk} = \mathbf{C}miit_{ijk} + \mathbf{C}xiit_{ijk} , \quad (15)$$

where the contributions of import and export growth to the growth in NT_{ijk} and IIT_{ijk} are calculated as

$$\mathbf{C}mnt_{ijk} = (M_{ijk} / (M_{ijk} - X_{ijk}))\, m_{ijk} , \quad (16)$$

$$\mathbf{C}xnt_{ijk} = (X_{ijk} / (X_{ijk} - M_{ijk}))\, x_{ijk} , \quad (17)$$

$$\mathbf{C}miit_{ijk} = \delta_{ijk}\, m_{ijk} \quad (18)$$

and

$$\mathbf{C}xiit_{ijk} = (1 - \delta_{ijk})\, x_{ijk} . \quad (19)$$

δ_{ijk} is 1 if $X_{ijk} > M_{ijk}$ and zero if $X_{ijk} < M_{ijk}$. (We assume that M_{ijk} is not precisely equal to X_{ijk}). Equations (14), (16) and (17) imply that both growth in imports and reductions in exports make positive contributions to net trade for net import products. Similarly, they make negative contributions to net trade for net export products. Equations (15), (18) and (19) reflect the fact that growth in imports determine the growth in IIT for net export products, while the growth in exports

(9) The assumption of independent determination of m_i and x_i is supported by the fact that the correlation coefficient is 0.113 for the period 1981 to 1986, and 0.009 for 1986 to 1991.

accounts for the growth in IIT for net import products.[10] These relationships are summarised in tabular form below.

Table 1: Relationship Between Industry Status and Import and Export Contributions to the Growth in TT, NT and IIT

	$\mathbf{C}mtt_{ijk}$	$\mathbf{C}xtt_{ijk}$	$\mathbf{C}mnt_{ijk}$	$\mathbf{C}xnt_{ijk}$	$\mathbf{C}miit_{ijk}$	$\mathbf{C}xiit_{ijk}$
Net Import Industries						
Imports ↑ (↓)	↑ (↓)	-	↑ (↓)	-	-	-
Exports ↑ (↓)	-	↑ (↓)	-	↓ (↑)	-	↑(↓)
Net Export Industries						
Imports ↑ (↓)	↑ (↓)	-	↓ (↑)	-	↑ (↓)	-
Exports ↑ (↓)	-	↑ (↓)	-	↑ (↓)	-	-

3.3 Decomposition of Growth in TT, NT and IIT: Contributions of Intra and Extra RTA Trade

In this subsection, we derive formulas that measure the contribution of intra and extra RTA trade to the growth in total multilateral TT, NT and IIT. Since the decomposition formulas for Australia and New Zealand are symmetrical, we derive the formulas for Australia's trade only (the formulas for New Zealand are obtained by substituting $j = A$ for $j = N$, and $k = N$ for $k = A$).

Australia's TT in commodity i ($\boldsymbol{TT}_{iAW}$) is the sum of intra RTA ($\boldsymbol{TT}_{iAN}$) and extra RTA trade ($\boldsymbol{TT}_{iAR}$):

$$\boldsymbol{TT}_{iAW} = \boldsymbol{TT}_{iAN} + \boldsymbol{TT}_{iAR} . \qquad (20)$$

(10) Note that our formulas for decomposing $\boldsymbol{NT}_i$ and $\boldsymbol{IIT}_i$ into the contributions of import and export growth (i.e. equations (14) through (19)) are only valid in the absence of status-switches. A status switch takes place for good i if it changes from being a net import at the beginning of the period of study to a net export at the end of the period or *vice versa*. With status switches, there is no solution to the problem of computing import and export contributions to growth in $\boldsymbol{NT}_i$ and $\boldsymbol{IIT}_i$. This is because the effect of import growth on $\boldsymbol{NT}_i$ or $\boldsymbol{IIT}_i$ depends on the extent of export growth. Similarly, the effect of export growth on $\boldsymbol{NT}_i$ and $\boldsymbol{IIT}_i$ depends on the extent of import growth. In other words, they are not independently determined. For this reason, the few industries for which we observed status-switches were excluded from our calculations of import and export contributions to $\boldsymbol{NT}_i$ and $\boldsymbol{IIT}_i$ growth in Section 5. A formal analysis of why our contributions measures are no longer valid in the presence of status switches is presented in Appendix A. This appendix also considers the combinations of import and export growth rates that can result in industries switching their status over time.

From (20) above, we find that

$$\mathbf{tt}_{iAW} = \mathbf{Ctt}_{iAN} + \mathbf{Ctt}_{iAR}\ , \quad (21)$$

where

$$\mathbf{Ctt}_{iAN} = (\mathbf{TT}_{iAN} / \mathbf{TT}_{iAW})\ \mathbf{tt}_{iAN}\ , \quad (22)$$

$$\mathbf{Ctt}_{iAR} = (\mathbf{TT}_{iAR} / \mathbf{TT}_{iAW})\ \mathbf{tt}_{iAR}\ , \quad (23)$$

and $\mathbf{tt}_{iAW}$ is the growth rate in $\mathbf{TT}_{iAW}$. That is, $\mathbf{Ctt}_{iAN}$ and $\mathbf{Ctt}_{iAR}$ are the contributions of growth in Australia's trade with New Zealand and Australia's extra New Zealand trade to growth in its total multilateral trade.

In deriving the formulas that measure the contributions of intra and extra RTA trade to the growth in Australia's or New Zealand's total multilateral NT and IIT, we must consider the effects of opposite signed imbalances. An opposite signed imbalance occurs if an industry is a net exporter to (net importer from) the region, but a net importer (net exporter) when it comes to total multilateral trade (and by definition, extra RTA trade as well). The contributions of intra and extra RTA trade to the growth in overall NT or IIT depend on the nature of the trade imbalance at the total multilateral level, and not on the nature of their respective trade imbalances. This is because intra and extra RTA NT or IIT measured using equations (3) and (4) will sum to total multilateral NT or IIT if and only if the trade imbalances at the intra and extra RTA levels have the same sign as that at the total multilateral level. More formally,

$$\mathbf{NT}_{iAW} = \mathbf{NT}_{iAN} + \mathbf{NT}_{iAR} \quad (24)$$

and

$$\mathbf{IIT}_{iAW} = \mathbf{IIT}_{iAN} + \mathbf{IIT}_{iAR} \quad (25)$$

only if $\mathbf{M}_{iAN} > \mathbf{X}_{iAN}$ and $\mathbf{M}_{iAR} > \mathbf{X}_{iAR}$, or $\mathbf{M}_{iAN} < \mathbf{X}_{iAN}$ and $\mathbf{M}_{iAR} < \mathbf{X}_{iAR}$.

With opposite signed imbalances, the contributions of intra and extra RTA trade to the growth in NT or IIT will be biased. This bias is reflected in the fact that growth in total multilateral NT or IIT will not equal the trade-weighted sum of growth contributions of intra and extra RTA NT or IIT if opposite signed imbalances exist.

In light of the above, the growth in Australia's total multilateral NT in commodity *i* is given by:

$$\mathbf{nt}_{iAW} = \mathbf{Cnt}_{iAN} + \mathbf{Cnt}_{iAR} \quad (26)$$

where nt_{iAW} is the growth rate in NT_{iAW}, and

$$\mathbf{C}nt_{iAN} = (M_{iAN} / NT_{iAW})\, m_{iAN} - (X_{iAN} / NT_{iAW})\, x_{iAN} \quad (27)$$

$$\mathbf{C}nt_{iAR} = (M_{iAR} / NT_{iAW})\, m_{iAR} - (X_{iAR} / NT_{iAW})\, x_{iAR} \quad (28)$$

if $M_{iAW} > X_{iAW}$, and

$$\mathbf{C}nt_{iAN} = (X_{iAN} / NT_{iAW})\, x_{iAN} - (M_{iAN} / NT_{iAW})\, m_{iAN} \quad (29)$$

$$\mathbf{C}nt_{iAR} = (X_{iAR} / NT_{iAW})\, x_{iAR} - (M_{iAR} / NT_{iAW})\, m_{iAR} \quad (30)$$

if $X_{iAW} > M_{iAW}$.

The growth in Australia's total multilateral IIT in commodity i is given by:

$$iit_{iAW} = \mathbf{C}iit_{iAN} + \mathbf{C}iit_{iAR} \quad (31)$$

where iit_{iAW} is the growth rate in IIT_{iAW}, and

$$\mathbf{C}iit_{iAN} = (X_{iAN} / X_{iAW})\, x_{iAN} \quad (32)$$

$$\mathbf{C}iit_{iAR} = (X_{iAR} / X_{iAW})\, x_{iAR} \quad (33)$$

if $M_{iAW} > X_{iAW}$, and

$$\mathbf{C}iit_{iAN} = (M_{iAN} / M_{iAW})\, m_{iAN} \quad (34)$$

$$\mathbf{C}iit_{iAR} = (M_{iAR} / M_{iAW})\, m_{iAR} \quad (35)$$

if $X_{iAW} > M_{iAW}$.[11]

To elucidate the nature and extent of the bias associated with ignoring opposite signed imbalances, consider, for instance, a case where $M_{iAW} > X_{iAW}$ but $M_{iAN} < X_{iAN}$. If we employed equation (3) to measure Australia-New Zealand NT (and thus ignoring the correction for opposite signed imbalances embodied in equation (27)), then the contribution of Australia-New Zealand trade to the growth in Australia's total multilateral NT would be biased by:

$$\{(2\,\Delta M_{iAN}) / NT_{iAW}\} - \{(2\,\Delta X_{iAN}) / NT_{iAW}\} \quad (36)$$

If equation (4) had been employed to measure Australia-New Zealand IIT, then the contribution of Australia-New Zealand trade to the growth in Australia's total multilateral IIT would have been overstated in this instance by:

$$(\Delta X_{iAN} / X_{iAW}) - (\Delta M_{iAN} / M_{iAW}) \quad (37)$$

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(11) Note that the decomposition formulas for NT and IIT do not apply to industries which switch their status over the period from net importers to net exporters or *vice-versa* (See Appendix A).

The correction for opposite signed imbalances embodied in equation (32) would remove this bias.

4. Data Issues

The definition of "industry" employed in compiling the data base is potentially important to the measurement of the contributions of growth in NT and IIT to the growth in TT. Sceptics such as Finger (1975), Lipsey (1976) and Rayment (1976) have argued that almost all measured IIT is purely a statistical artefact brought about by trade data having been grouped in heterogeneous categories. In a sense they are right. At an extremely fine level of disaggregation, there will be little or no IIT.

However, as explained in Section 1, our interest in the measurement of the contributions of growth in IIT and NT to the growth in TT reflects our concern with adjustment problems associated with trade growth and liberalisation. For looking at adjustment problems, we need industry categories within which a high degree of factor mobility is possible. To meet this criterion, we judged that disaggregation at the 3-digit SITC level is sufficient. At this level, we have industries such as inorganic acids (SITC 523), paints (SITC 533), paper and paperboard (SITC 641), glass (SITC 664), glassware (SITC 665), tractors (SITC 722), television receivers (SITC 761), and furniture (SITC 821). It is reasonable to assume that the cost of reallocating factors within such industries is low. Consequently, we worked with data at this level covering 130 manufacturing industries belonging to SITC 5-8 less 67-68 (metals).

For this set of 130 industries, we found that one industry switched from a net import to a net export, while another switched in the opposite direction between 1981 and 1986. Between 1986 and 1991, five industries switched from net import to net export industries, while one industry switched in the opposite direction. These 8 industries were excluded from our computations of import and export growth contributions to the growth in NT and IIT, the contributions of intra and extra RTA components to the growth in NT and IIT, and contributions of intra and extra RTA NT and IIT to the growth in TT.

The data relate to the calender years 1981, 1986 and 1991, and come from the United Nations' COMTRADE data base.

5. Results

The results of computations of various contribution measures are presented in Tables 2 to 4. While the computations are carried out using data for the 130 manufacturing industries, the tables contain various aggregations of our results.[12] The aggregation formulas are in the notes at the end of the tables.

5.1 Contributions of Growth in NT and IIT to the Growth in TT, and Contributions of Growth in Imports and Exports to the Growth in TT, NT and IIT

Table 2 contains contributions of growth in NT and IIT to the growth in TT, and contributions of growth in imports and exports to the growth in TT, NT and IIT for Australia's trade with New Zealand.[13] The results presented in Table 2 are aggregations based on (i) industry status (i.e. net export or net import), (ii) SITC 1-digit categories, and (iii) total manufacturing. We begin by considering the period 1981 to 1986. The growth in Australia's TT in total manufacturing with New Zealand is more than accounted for by growth in IIT; the contribution of NT growth is negative. The negative contribution of NT growth has the effect of reducing growth in TT from 8.47 percent (the contribution of IIT) to 4.61 percent. Imports from New Zealand grew by 6.77 percent, while exports fell by 2.16 percent. NT fell by 8.17 percent as a result of a large negative contribution from exports. In fact, NT would have fallen by 15.45 percent if not for a positive contribution from imports of 7.28 percent. From the results that separate net import industries from net export industries, we can see that the positive contribution of imports to the growth in NT is due to net import industries increasing their imports. The negative contribution of exports, on the other hand, is due to a combination of net import industries increasing their exports and net export industries decreasing their exports. Turning to the growth in IIT, we find that most of the growth of 26.50 percent is due to the contribution of exports. The 22.01 percent contribution of exports is a result of net import industries increasing their exports. The remaining 4.49 percent contribution from imports is a result of net export industries increasing their imports.

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(12) The detailed results for the 130 industries are available on request.

(13) The contributions of NT and IIT to the growth in TT are the same for Australia-New Zealand and New Zealand-Australia trade. To obtain the contributions of imports and exports to the growth in TT, NT and IIT for New Zealand-Australia trade from Table 2, read import contributions as export contributions and *vice-versa* in all cases. Finally note that industries that are net importers (net exporters) for Australia-New Zealand trade are net export (net import) industries when it comes to New Zealand-Australia trade.

With respect to our SITC 1-digit categories, we find that the contribution of NT to the growth in TT is negative in all cases expect for Materials (SITC 6), where is it positive but negligible. Miscellaneous manufacturing (SITC 8) has the largest positive contribution from IIT of 18.32 percent, and the largest negative contribution from NT of -14.98 percent.

Next we turn to the period 1986 to 1991. This period is characterised by very strong growth in trans-Tasman trade. The growth in TT of total manufacturing of 97.12 percent is a result of a 54.79 percent contribution from IIT growth and 42.32 percent contribution from NT growth. Export growth contributes 58.12 percent to this growth in TT, while import growth accounts for the remaining 39.00 percent. NT grew by 74.94 percent, with relatively equal contributions from imports (39.94 percent) and exports (34.99 percent). By referring to the results for net import and net export industries, we can see that the import contribution to the growth in NT is due to net import industries increasing their imports, while the export contribution is a result of net export industries increasing their exports. But the import and export contributions (and thus growth in NT) would have been much higher if not for net export industries increasing their exports, and net import industries increasing their exports. In fact, the contribution of imports to the growth in NT would have been 95.87 percent (the contribution of imports to the growth in NT of net import industries) instead of 39.94 percent if not for the export growth from net import industries. Similarly, the contribution of exports to the growth in NT would have been 125.95 percent (the contribution of exports to the growth in NT of net export industries) instead of 34.99 percent if not for the import growth from net export industries. While both these effects tend to reduce the growth in NT by reducing the contributions of imports and exports, they account for the growth in IIT. The 94.05 percent growth in IIT is made up of a 30.73 percent contribution from imports, and 63.32 percent contribution from exports. The contribution from imports is due to import growth in net export industries, while the contribution from exports is due to export growth in net import industries.

Turning to the SITC 1-digit categories, we find that the contribution of IIT to the growth in TT is greater than that of NT in all sectors except Chemicals (SITC 5).

Table 2: Contributions Measures and GL Indexes, 1981 to 1986 and 1986 to 1991[1]

1981 to 1986	$tt(g)_{jk}$	$Cnt(g)_{jk}$	$Ciit(g)_{jk}$	$GL(g)_{jk(81)}$	$GL(g)_{jk(86)}$	$Cmtt(g)_{jk}$	$Cxtt(g)_{jk}$	$nt(g)_{jk}$	$Cmnt(g)_{jk}$	$Cxnt(g)_{jk}$	$iit(g)_{jk}$	$Cmiit(g)_{jk}$	$Cxiit(g)_{jk}$
Total Manufacturing	4.61	-3.86	8.47	0.42	0.48	6.77	-2.16	-8.17	7.28	-15.45	26.50	4.49	22.01
Net Import Industries	18.82	2.65	16.17	0.38	0.43	10.74	8.09	4.24	17.19	-12.95	43.07	0.00	43.07
Net Export Industries	-9.72	-13.07	3.36	0.37	0.42	1.68	-11.40	-20.60	-2.65	-17.96	9.19	9.19	0.00
Chemicals (SITC 5)	5.69	-8.73	14.42	0.37	0.49	16.26	-10.57	-14.95	-1.96	-12.99	38.30	43.02	-4.72
Materials (SITC 6)	7.88	1.05	6.83	0.39	0.42	3.96	3.92	-0.04	9.50	-9.54	34.65	2.76	31.89
Machinery (SITC 7)	1.39	-1.36	2.75	0.47	0.49	6.88	-5.49	-3.77	14.03	-17.80	8.43	-8.08	16.51
Miscellaneous (SITC 8)	3.34	-14.98	18.32	0.41	0.57	5.09	-1.76	-28.91	-2.06	-26.84	41.49	5.52	35.97
1986 to 1991	$tt(g)_{jk}$	$Cnt(g)_{jk}$	$Ciit(g)_{jk}$	$GL(g)_{jk(86)}$	$GL(g)_{jk(91)}$	$Cmtt(g)_{jk}$	$Cxtt(g)_{jk}$	$nt(g)_{jk}$	$Cmnt(g)_{jk}$	$Cxnt(g)_{jk}$	$iit(g)_{jk}$	$Cmiit(g)_{jk}$	$Cxiit(g)_{jk}$
Total Manufacturing	97.12	42.32	54.79	0.48	0.52	39.00	58.12	74.94	39.94	34.99	94.05	30.73	63.32
Net Import Industries	79.86	29.71	50.15	0.43	0.52	54.79	25.07	51.99	95.87	-43.88	117.03	0.00	117.03
Net Export Industries	86.83	58.49	28.33	0.42	0.38	14.17	72.66	101.39	-24.55	125.95	66.96	66.96	0.00
Chemicals (SITC 5)	133.44	79.67	53.77	0.49	0.44	36.72	96.73	99.47	3.89	95.57	112.14	46.60	65.55
Materials (SITC 6)	68.23	30.01	38.21	0.42	0.48	36.13	32.10	48.34	44.80	3.55	83.79	24.29	59.50
Machinery (SITC 7)	90.29	36.12	54.17	0.49	0.54	32.09	58.20	58.73	16.38	42.35	108.17	42.33	65.84
Miscellaneous (SITC 8)	143.31	51.28	92.02	0.57	0.61	59.88	83.43	200.45	134.39	66.05	79.05	13.21	65.84

Notes:

(1) In all the formulas below, the s(g)'s are sets of products. For instance, in the first row of the table, g = total manufacturing. In the second row, g = net import industries, i.e. all industries for which $M_{iAN} > X_{iAN}$ in 1981. To obtain these aggregates, we begin by defining the following:

$$TT(g)_{jk} = \Sigma_{i \in s(g)} TT_{ijk} \quad (1)$$

$$NT(g)_{jk} = \Sigma_{i \in s(g)} NT_{ijk} \quad (2)$$

$$IIT(g)_{jk} = \Sigma_{i \in s(g)} IIT_{ijk} \quad (3)$$

$$GL(g)_{jk} = \Sigma_{i \in s(g)} GL_{ijk} \, (TT_{ijk} / (TT(g)_{jk}) \quad (4)$$

Using equations (1) to (4) above, we obtain:

$$tt(g)_{jk} = \Sigma_{i \in s(g)} tt_{ijk} \, (TT_{ijk} / TT(g)_{jk}) \quad (5)$$

$$nt(g)_{jk} = \Sigma_{i \in s(g)} nt_{ijk} \, (NT_{ijk} / (NT(g)_{jk}) \quad (6)$$

$$iit(g)_{jk} = \Sigma_{i \in s(g)} iit_{ijk} \, (IIT_{ijk} / (IIT(g)_{jk}) \quad (7)$$

$$Cnt(g)_{jk} = (1 - GL(g)_{jk}) \, nt(g)_{jk} \quad (8)$$

$$Ciit(g)_{jk} = GL(g)_{jk} \, iit(g)_{jk} \quad (9)$$

$$Cmtt(g)_{jk} = \Sigma_{i \in s(g)} Cmtt_{ijk} \, (TT_{ijk} / TT(g)_{jk}) \quad (10)$$

$$Cxtt(g)_{jk} = \Sigma_{i \in s(g)} Cxtt_{ijk} \, (TT_{ijk} / TT(g)_{jk}) \quad (11)$$

$$Cmnt(g)_{jk} = \Sigma_{i \in s(g)} Cmnt_{ijk} \, (NT_{ijk} / (NT(g)_{jk}) \quad (12)$$

$$Cxnt(g)_{jk} = \Sigma_{i \in s(g)} Cxnt_{ijk} \, (NT_{ijk} / (NT(g)_{jk}) \quad (13)$$

$$Cmiit(g)_{jk} = \Sigma_{i \in s(g)} Cxiit_{ijk} \, (IIT_{ijk} / (IIT(g)_{jk}) \quad (14)$$

$$Cxiit(g)_{jk} = \Sigma_{i \in s(g)} Cxiit_{ijk} \, (IIT_{ijk} / (IIT(g)_{jk}) \quad (15)$$

Table 3: Contributions of Intra and Extra RTA Trade to the Growth in Total Multilateral TT, NT and IIT

Source	Period	$tt(g)_{AW}$	$Ctt(g)_{AN}$	$Ctt(g)_{AR}$	$nt(g)_{AW}$	$Cnt(g)_{AN}$	$Cnt(g)_{AR}$	$iit(g)_{AW}$	$Ciit(g)_{AN}$	$Ciit(g)_{AR}$
Australia	81-86	10.17	0.23	9.94	16.81	0.63	16.18	-11.04	-0.95	-10.09
	86-91	68.25	4.55	63.71	45.87	-1.15	47.02	165.75	29.58	136.17
Source	Period	$tt(g)_{NW}$	$Ctt(g)_{NA}$	$Ctt(g)_{NR}$	$nt(g)_{NW}$	$Cnt(g)_{NA}$	$Cnt(g)_{NR}$	$iit(g)_{NW}$	$Ciit(g)_{NA}$	$Ciit(g)_{NR}$
New Zealand	81-86	25.21	0.96	24.25	23.80	-2.70	26.50	23.95	11.21	12.74
	86-91	47.40	16.88	30.52	35.50	7.99	27.50	74.57	35.67	38.91

Table 3a: Bias Associated with Ignoring Opposite Signed Imbalances: Effect on Contribution Measures of Intra and Extra RTA Trade to the Growth in Total Multilateral NT and IIT[1]

Source	Period	$Cnt(g)_{AN}$	$Cnt(g)_{AR}$	$Ciit(g)_{AN}$	$Ciit(g)_{AR}$
Australia	81-86	-0.21	16.19	1.78	-10.11
		(0.84)	(-0.01)	(-2.73)	(0.03)
	86-91	2.25	47.02	14.16	136.17
		(-3.41)	(0.00)	(15.42)	(0.00)
Source	Period	$Cnt(g)_{NA}$	$Cnt(g)_{NR}$	$Ciit(g)_{NA}$	$Ciit(g)_{NR}$
New Zealand	81-86	-0.61	26.23	4.51	13.60
		(-2.08)	(0.27)	(6.70)	(-0.86)
	86-91	8.52	28.79	34.01	34.82
		(-0.52)	(-1.28)	(1.66)	(4.08)

Notes:

(1) Figures in parentheses represent the bias in the uncorrected contribution measures.

5.2 Contributions of Intra and Extra RTA Trade to the Growth in TT, NT and IIT

Table 3 contains our contributions of intra and extra RTA trade to the growth in multilateral TT, NT and IIT for Australia and New Zealand covering the periods 1981 to 1986 and 1986 to 1991. We begin by considering Australia's trade during 1981 to 1986. Trade with New Zealand contributed a very minor portion (0.23 percent) of the overall growth in TT of 10.17 percent. The relatively minor role of trade with New Zealand during this period is also reflected in its contributions to the growth in Australia's NT and IIT. Trade with New Zealand contributed 0.63 percent of the 16.81 percent growth in Australia's multilateral NT, and 0.95 percent of the 11.4 percent negative growth in IIT.

The period 1986 to 1991 is associated with an increase in the importance of trade with New Zealand. Trade with New Zealand contributes 4.55 percent of the overall growth in TT of 68.25 percent. Trade with New Zealand has the effect of reducing the growth in Australia's NT from 47.02 percent to 45.87 percent. The 165.75 percent growth in Australia's IIT is a result of a 29.58 percent contribution from trade with New Zealand, and 136.17 percent contribution from extra RTA trade.

Next we turn to explaining New Zealand's multilateral trade. Between 1981 and 1986, New Zealand's multilateral TT grew by 25.21 percent, with trade with Australia contributing only 0.96 percent. Trade with Australia has the effect of reducing the growth in New Zealand's NT from 26.50 percent to 23.80 percent. Trade with Australia makes a significant contribution to the growth in New Zealand's IIT. 11.21 percent of the 23.95 percent growth in New Zealand's IIT is a result of trans-Tasman trade. This contribution of close to half the growth in IIT is quite remarkable given that trade with Australia contributes less than 5 percent of New Zealand's growth in TT.

Between 1986 and 1991, New Zealand TT grew by 47.40 percent, with trade with Australia contributing 16.88 percent. New Zealand's NT grew by 35.50 percent, with extra RTA trade contributing the dominant share of 27.50 percent. 35.67 percent of the 74.57 percent growth in New Zealand's IIT is due to trade with Australia.

In Section 3 we showed, as a theoretical possibility, that the contributions of intra and extra RTA NT and IIT would be biased in the presence of opposite signed trade imbalances at the intra and extra RTA levels. In Table 3a we report the contribution measures computed independently of the trade imbalance at the multilateral level, and the resulting biases (in parentheses). It is clear that the

biases associated with the contributions of trans-Tasman trade, as a result of ignoring the trade imbalance at the multilateral level, are substantial. With respect to the effect that trade with New Zealand has on the growth in Australia's NT and IIT between 1981 and 1986, the bias is substantial enough to reverse the sign on the respective contribution measures. That is, from 0.63 to -0.21 for NT, and -0.95 to 1.78 for IIT. For the period 1986 to 1991, the bias reverses the sign on the contribution of trade with New Zealand to the growth in Australia's NT (from -1.15 to 2.25), while it more than halves the contribution of trans-Tasman trade to IIT from 29.58 percent to 14.16 percent.

In the case of New Zealand's trade between 1981 and 1986, the bias associated with trade with Australia reduces the trans-Tasman contribution to growth in NT from -2.70 to -0.61, and 11.21 to 4.51 for the trans-Tasman contribution to growth in IIT. For the period 1986 to 1991, the biases associated with trans-Tasman trade are less substantial than the biases resulting from extra RTA trade. The contribution of extra RTA trade to the growth in New Zealand's NT is 27.50 percent, but the (positive) bias of 1.28 percent would have increased it to 28.79 percent. Similarly, the contribution of extra RTA trade to the growth in New Zealand's IIT is 35.67 percent, but the (negative) bias of 1.66 percent would have reduced it to 34.01 percent.

The source of these biases are brought out in Table 4, where we report the number of industries that have trade imbalances at the intra and extra RTA levels that are oppositely signed to that at the multilateral level. The substantial biases associated with the contribution of trans-Tasman trade to Australia's multilateral trade emanates from the fact that a large number (76, 71 and 80 industries in 1981, 1986 and 1991, respectively, out of a total of 130) of Australian industries that are net importers from the world are also net exporters to New Zealand. For these industries, any growth in imports from (exports to) New Zealand should be recorded as contributions to growth in Australia's multilateral NT (IIT), but would have been recorded as contributions to growth in IIT (NT) if the multilateral trading position had been ignored.

Table 4
Opposite Signed Imbalances in Intra and Extra RTA Trade (Number of Industries)

Source	Period	$M_{iAW} > X_{iAW}$ $M_{iAN} < X_{iAN}$	$M_{iAW} < X_{iAW}$ $M_{iAN} > X_{iAN}$	$M_{iAW} > X_{iAW}$ $M_{iAR} < X_{iAR}$	$M_{iAW} < X_{iAW}$ $M_{iAR} > X_{iAR}$	$M_{iAN} > X_{iAN}$ $M_{iAR} > X_{iAR}$	$M_{iAN} < X_{iAN}$ $M_{iAR} < X_{iAR}$	Total
Australia	1981	76	1	2	1	48	2	130
	1986	71	1	1	0	54	3	130
	1991	80	4	0	0	42	4	130
Source	Period	$M_{iNW} > X_{iNW}$ $M_{iNA} < X_{iNA}$	$M_{iNW} < X_{iNW}$ $M_{iNA} > X_{iNA}$	$M_{iNW} > X_{iNW}$ $M_{iNR} < X_{iNR}$	$M_{iNW} < X_{iNW}$ $M_{iNR} > X_{iNR}$	$M_{iNA} > X_{iNA}$ $M_{iNR} > X_{iNR}$	$M_{iNA} < X_{iNA}$ $M_{iNR} < X_{iNR}$	Total
New Zealand	1981	33	2	2	7	75	13	132
	1986	43	4	1	7	69	8	132
	1991	35	1	1	6	82	7	132

In the case of New Zealand, a smaller but still substantial number of industries (33, 43 and 35 industries in 1981, 1986 and 1991, respectively, out of a total of 130) were net importers from the world but net exporters to Australia. There are also 7 industries that were net exporters to the world but net importers with respect to extra RTA trade.[14] This would explain the relatively large biases associated with the contribution of extra RTA trade to the growth in New Zealand's NT and IIT between 1986 and 1991.

6. Concluding Remarks

Empirical work on IIT is almost 30 years old. From the earliest analyses of IIT, the phenomenon has been associated with Regional Trading Agreements (RTAs). In attempting to determine whether RTAs are associated with increases in IIT, previous researchers have looked at two questions: (i) whether IIT has increased following the formation of the RTA, and (ii) whether IIT is more important in intra versus extra RTA trade. To answer the first question, researchers have used movements in the value of the GL index over time, while the second has been dealt with by comparing the value of the GL index for intra versus extra RTA trade. Employing the GL index in these ways to answer these questions can lead to error. In this paper, we developed a new methodology for analysing both of these questions which overcomes the problems associated with using the GL index. First, we derived a formula which decomposes the growth in TT into the contributions of growth in IIT and NT. Second, we measured the contributions of intra and extra RTA trade to the growth in a country's total multilateral IIT and NT. All our formulas were computed with data for 130 Australian and New Zealand manufacturing industries defined at the 3-digit level of the Standard International Trade Classification (SITC) for the periods 1981 to 1986 and 1986 to 1991.

A number of interesting results emerge from our analysis, particularly for the period 1986 to 1991. First, while the contribution of IIT to the growth in trans-Tasman trade has been important in both periods, its contribution is particularly substantial (54.79 out of 97.12 percent) during the period 1986 to 1991. Second, while intra RTA trade contributes only 4.55 percent of the growth in Australia's total multilateral TT between 1986 and 1991, intra RTA trade contributes a disproportionately high share of 29.58 percent to the overall growth in IIT of 165.75 percent. The contribution of intra RTA trade to the growth in New Zealand's overall IIT is more substantial. While intra RTA trade contributed 16.88 percent to

(14) It follows that these 7 industries would be very large exporters to the Australian market.

the overall growth in New Zealand's TT of 47.40, intra RTA trade contributed 35.67 percent of the total multilateral growth in IIT of 74.57 percent between 1986 and 1991. We found that the biases associated with ignoring the relationship between the trade imbalance at the multilateral level and that at the intra RTA level in particular to be quite substantial for both Australia's and New Zealand's trade.

Appendix A
Status-Switches

As mentioned in Section 3.2, our formulas for decomposing NT_{ijk} and IIT_{ijk} into the contributions of import and export growth and contributions of intra and extra RTA trade to the growth in total multilateral NT and IIT are only valid in the absence of status-switches. Status switches take place for net import industries ($M_{ijk} > X_{ijk}$) if and only if:

$$m_{ijk} < ((X_{ijk} / M_{ijk}) - 1) + (X_{ijk} / M_{ijk})\ x_{ijk} . \quad (38)$$

Status switches take place for net export industries ($X_{ijk} > M_{ijk}$) if and only if:

$$x_{ijk} < ((M_{ijk} / X_{ijk}) - 1) + (M_{ijk} / X_{ijk})\ m_{ijk} . \quad (39)$$

The shaded area above the line AB in Figure 1 shows the combinations of growth rates in M_{ijk} and X_{ijk} for which there is no status switch for net import industries, while the unshaded area below the line shows combinations for which there is a status switch. Similarly, if we assume that X_{ijk} is initially greater than M_{ijk}, then the shaded area above the line AB in Figure 2 shows no-switch combinations, while the unshaded area below the line shows switch combinations.

To illustrate why these contribution measures are invalid in the presence of status-switches, we examine the effects on the contributions of growth in imports and exports to the growth in NT and IIT (the outcome for the contributions of intra and extra RTA trade to the growth in total multilateral NT and IIT are similar). In the case where the status of a product switches from a net import to a net export or *vice versa*, we find that:

$$nt_{ijk} = -2 + (M_{ijk} / (X_{ijk} - M_{ijk}))\ m_{ijk} + (X_{ijk} / (M_{ijk} - X_{ijk}))\ x_{ijk} \quad (40)$$

and

$$iit_{ijk} = ((M_{ijk} / X_{ijk}) - 1) + (M_{ijk} / X_{ijk})\ m_{ijk} \text{ , for } M_{ijk} > X_{ijk} \text{ initially,} \quad (41)$$

or

$$iit_{ijk} = ((X_{ijk} / M_{ijk}) - 1) + (X_{ijk} / M_{ijk})\ x_{ijk} \text{ , for } X_{ijk} > M_{ijk} \text{ initially.} \quad (42)$$

Figure 1: 'Switch' and 'No Switch' m_i - x_i Combinations when $M_i > X_i$

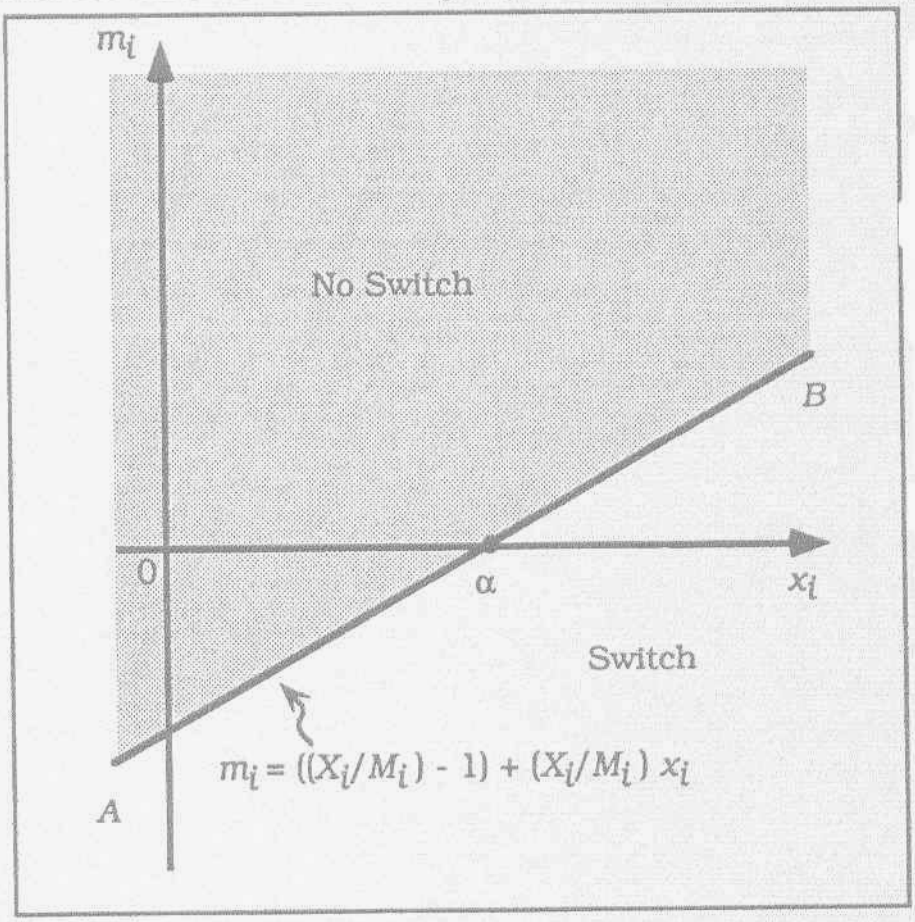
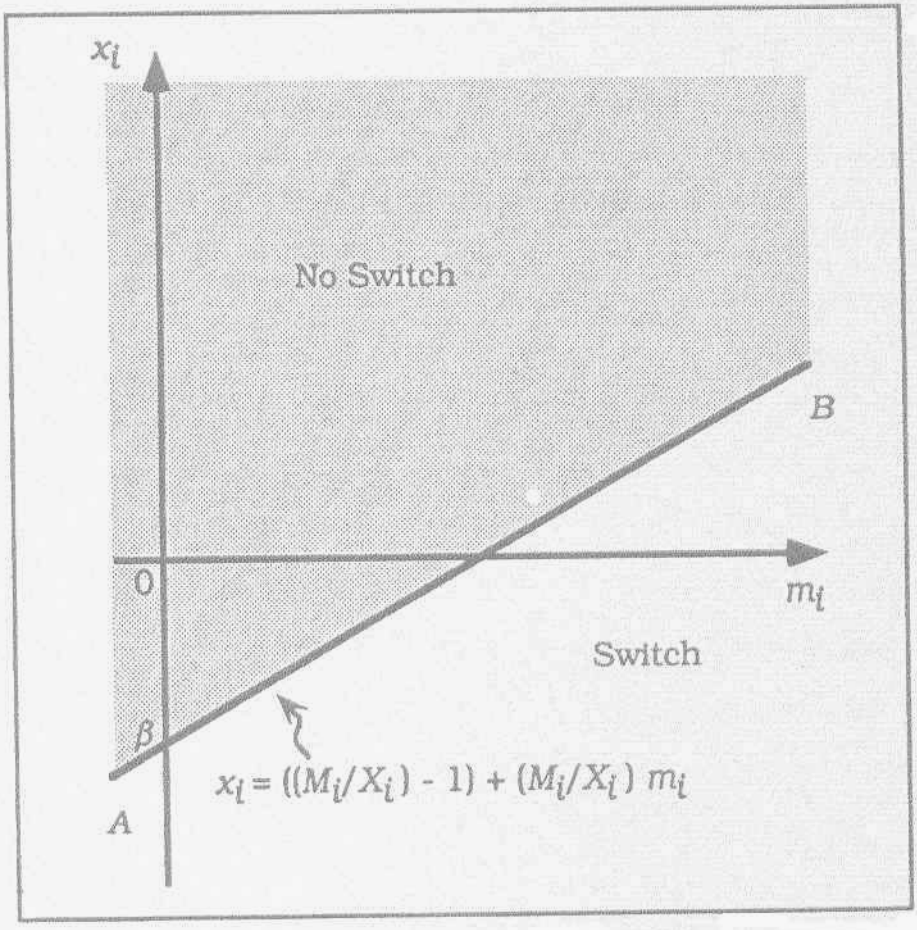


Figure 2: 'Switch' and 'No Switch' m_i - x_i Combinations when $X_i > M_i$



On the basis of these formulas, it is tempting to consider $(\boldsymbol{M}_{ijk}/(\boldsymbol{X}_{ijk} - \boldsymbol{M}_{ijk}))\ \boldsymbol{m}_{ijk}$ as the contribution of import growth to growth in $\boldsymbol{NT}_{ijk}$; $(\boldsymbol{X}_{ijk}/(\boldsymbol{M}_{ijk} - \boldsymbol{X}_{ijk})\ \boldsymbol{x}_{ijk}$ as the contribution of export growth to $\boldsymbol{NT}_{ijk}$; etc. However, $(\boldsymbol{M}_{ijk}/(\boldsymbol{X}_{ijk} - \boldsymbol{M}_{ijk}))\ \boldsymbol{m}_{ijk}$, for instance, will not normally be the effect on growth of $\boldsymbol{NT}_{ijk}$ of reducing $\boldsymbol{m}_{ijk}$ to zero. In terms of our figures, we are dealing with $\boldsymbol{x}_{ijk}$-$\boldsymbol{m}_{ijk}$ combinations below the AB lines. Moving $\boldsymbol{m}_{ijk}$ from its observed level to zero will, very often, involve crossing the AB line. Once we cross this line, equations (14) and (15) are no longer valid. That is, in Figure 1, we will cross the AB line if $\boldsymbol{x}_{ijk} > \alpha$. In Figure 2, we will cross the AB line if $\boldsymbol{x}_{ijk} > \beta$.

As we noted in Section 3.2, there is no solution to the problem of computing import and export growth contributions to growth in $\boldsymbol{NT}_{ijk}$ and $\boldsymbol{IIT}_{ijk}$. For variations in $\boldsymbol{x}_{ijk}$-$\boldsymbol{m}_{ijk}$ combinations over our range of interest (including the (0,0) combination), the effect of import growth on $\boldsymbol{NT}_{ijk}$ or $\boldsymbol{IIT}_{ijk}$ depends on the extent of export growth. Similarly, the effect of export growth on $\boldsymbol{NT}_{ijk}$ and $\boldsymbol{IIT}_{ijk}$ depends on the extent of import growth.

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