Regional Trading Agreements and Intra-industry Trade[*]

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Abstract

Do Regional Trading Agreements (RTAs) promote intra-industry trade (IIT)? In attempting to answer this question, previous researchers have looked at two issues: (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 analyzing both of these questions which overcomes this problem. 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 contribution of intra and extra RTA trade to the growth in a country's total multilat-

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eral IIT and NT. These formulas are employed to examine the effects of the Australia-New Zealand Closer Economic Relations Trading Agreement (ANZCERTA) on Australian and New Zealand trade.

I. Introduction

Empirical work on intra-industry trade (IIT) is almost 30 years old. From the earliest analysis 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 Dixon and Menon [1995]⟩. 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 specialization 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 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], Greenaway [1982], Drabek and Greenaway [1984], Bano and Lane [1987], Globerman and Dean [1990], Globerman [1992], and Shelburne [1994].

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 IIT growth 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.[1] 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 imbal-

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1. 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.

ances exist.[2] In this instance, it is no longer the case, for example, that a lower value of the GL index for intra RTA trade as 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?" 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 contributions 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 II provides a brief overview of the ANZCERTA, focusing on trade developments leading up to it, and its reforms. Section III contains the derivations of the decomposition formulas.

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

Data issues are discussed in Section IV. Results of our study are presented in Section V, while a final section summarizes the main points.

II. 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) harmonize customs procedures, business laws, quarantine arrangements and technical barriers to trade, and (iv) extend the agenda to services and to investment.[3]

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3. For a more detailed discussion of the ANZCERTA, see Globerman and Dean [1990] and Menon [1994].

III. Analytical Framework

A. 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):

$$TT_{ijk} = NT_{ijk} + IIT_{ijk}, \tag{1}$$

where $\quad TT_{ijk} = X_{ijk} + M_{ijk}, \tag{2}$

$$NT_{ijk} = |X_{ijk} - M_{ijk}| \tag{3}$$

and $\quad IIT_{ijk} = (X_{ijk} + M_{ijk}) - |X_{ijk} - M_{ijk}|. \tag{4}$

X_{ijk} and M_{ijk} are exports to, and imports from, country (or group of countries) k of country j of commodity i.

The percentage growth in total trade between countries j and k of commodity i (tt_{ijk}) over any period is given by:

$$tt_{ijk} = Cnt_{ijk} + Ciit_{ijk}, \tag{5}$$

where $\quad Cnt_{ijk} = (1 - GL_{ijk})\, nt_{ijk}, \tag{6}$

$$Ciit_{ijk} = GL_{ijk}\, iit_{ijk}, \tag{7}$$

$$GL_{ijk} = IIT_{ijk} / TT_{ijk} \tag{8}$$

and nt_{ijk} and iit_{ijk} are the percentage changes over the period in NT_{ijk} and IIT_{ijk}.[4] Note that

$$GL_{ijk} = 1 - \{|X_{ijk} - M_{ijk}| / (X_{ijk} + M_{ijk})\},$$

which is the Grubel-Lloyd index of intra-industry trade at the beginning of the period.[5]

In our study of Australian and New Zealand trade reported in Section V, j

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4. Equation (5) is obtained by first taking the total differential of equation (1):

$dTT_{ijk} = (\delta TT_{ijk}/\delta NT_{ijk})dNT_{ijk} + (dTT_{ijk}/dIIT_{ijk})dIIT_{ijk} = dNT_{ijk} + dIIT_{ijk}.$

To obtain a percentage change form, divide through by TT_{ijk}:

$dTT_{ijk}/TT_{ijk} = (dNT_{ijk}/TT_{ijk})\,(NT_{ijk}/NT_{ijk}) + (dIIT_{ijk}/TT_{ijk})\,(IIT_{ijk}/IIT_{ijk}).$

5. Formulas that measure the contributions of growth in imports and exports to the growth in TT, NT and IIT are presented in Menon and Dixon [1996].

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

In section V, we find that growth rates in NT are largely uncorrelated with growth rates in IIT.[6] Under the assumption that nt_{ijk} is determined independently of iit_{ijk}, Cnt_{ijk} is the contribution to growth in total trade of growth in net trade, while $Ciit_{ijk}$ 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. 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 (Cnt_{ijk} and $Ciit_{ijk}$). These take account not only of growth rates in intra-industry and net trade, but also of their shares in total trade. More formally:

$$iit_{ijk} \quad > \quad nt_{ijk} \text{ implies } GL_{ijk} \text{ is increasing,}$$

$$\text{but if} \quad GL_{ijk} \quad < \quad nt_{ijk}/(nt_{ijk}+iit_{ijk}), \tag{9}$$

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

$$\text{then} \quad Ciit_{ijk} \quad < \quad Cnt_{ijk}.[7]$$

$$\text{Similarly,} \quad nt_{ijk} \quad > \quad iit_{ijk} \text{ implies that } GL_{ijk} \text{ is decreasing,}$$

$$\text{but if} \quad GL_{ijk} \quad > \quad nt_{ijk}/(nt_{ijk} + iit_{ijk}) \tag{9a}$$

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

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6. 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]⟩.

7. Equations (9) and (10) imply that:

$$GL_i\, nt_i + GL_i\, iit_i \quad < \quad nt_i,$$

i.e. $\quad -(1 - GL_i)nt_i + GL_i\, iit_i \quad < \quad 0,$

i.e. $\quad Ciit_i \quad < \quad Cnt_i.$

then Cnt_{ijk} $<$ $Ciit_{ijk}$.

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

B. Decomposition of 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 (TT_{iAW}) is the sum of intra RTA (TT_{IAN}) and extra RTA trade (TT_{iAR}):

$$TT_{iAW} = TT_{iAN} + TT_{iAR}. \tag{11}$$

From (11) above, we find that

$$tt_{iAW} = Ctt_{iAN} + Ctt_{iAR}, \tag{12}$$

where $Ctt_{iAN} = (TT_{iAN}/TT_{iAW})\, tt_{iAN}, \tag{13}$

$$Ctt_{iAR} = (TT_{iAR}/TT_{iAW})\, tt_{iAR}, \tag{14}$$

and tt_{iAW} is the growth rate in TT_{iAW}. That is, Ctt_{iAN} and 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.[8] More formally,

$$NT_{iAW} \quad = \quad NT_{iAN} + NT_{iAR} \qquad (15)$$

and $\quad IIT_{iAW} \quad = \quad IIT_{iAN} + IIT_{iAR} \qquad (16)$

only if $M_{iAN} > X_{iAN}$ and $M_{iAR} > X_{iAR}$, or $M_{iAN} < X_{iAN}$ and $M_{iAR} < X_{iAR}$.

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:

$$nt_{iAW} \quad = \quad Cnt_{iAN} + Cnt_{iAR} \qquad (17)$$

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

$$Cnt_{iAN} \quad = \quad (M_{iAN}/NT_{iAW})\, m_{iAN} - (X_{iAN}/NT_{iAW})x_{iAN} \qquad (18)$$
$$Cnt_{iAR} \quad = \quad (M_{iAR}/NT_{iAW})\, m_{iAR} - (X_{iAR}/NT_{iAW})x_{iAR} \qquad (19)$$

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

$$Cnt_{iAN} \quad = \quad (X_{iAN}/NT_{iAW})x_{iAN} - (M_{iAN}/NT_{iAW})m_{iAN} \qquad (20)$$
$$Cnt_{iAR} \quad = \quad (X_{iAR}/NT_{iAW})x_{iAR} - (M_{iAR}/NT_{iAW})m_{iAR} \qquad (21)$$

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

m_{i} and x_{i} are growth rates in M_{i} and X_{i}, respectively.

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

$$iit_{iAW} \quad = \quad Ciit_{iAN} + Ciit_{iAR} \qquad (22)$$

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

$$Ciit_{iAN} \quad = \quad (X_{iAN}/X_{iAW})x_{iAN} \qquad (23)$$
$$Ciit_{iAR} \quad = \quad (X_{iAR}/X_{iAW})x_{iAR} \qquad (24)$$

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8. Thus, in the presence of opposite-signed imbalances at the intra and extra regional levels, aggregation at the regional level is no longer a straight forward issue, and can lead to biased results when examining the effect of intra or extra RTA trade on a country's total multilateral IIT or NT.

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

$$Ciit_{iAN} = (M_{iAN}/M_{iAW})m_{iAN} \qquad (25)$$

$$Ciit_{iAR} = (M_{iAR}/M_{iAW})m_{iAR} \qquad (26)$$

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

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 (18)), then the contribution of Australia-New Zealand trade to the growth in Australia's total multilateral NT would be biased by:

$$\{(2\Delta M_{iAN})/NT_{iAW}\} - \{(2\Delta X_{iAN})/NT_{iAW}\} \qquad (27)$$

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:

$$(\Delta X_{iAN}/X_{iAW}) - (\Delta M_{iAN}/M_{iAW}) \qquad (28)$$

The correction for opposite signed imbalances embodied in equation (23) would remove this bias.

IV. Data Issues

The definition of "industry" employed in compiling the data base is potentially important to the measurement of the contributions of 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 artifact 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.[9]

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9. For a discussion of the effects of categorical aggregation on the measurement of IIT, see Appendix C of Menon [1996].

However, as explained in Section I, our interest in the measurement of the contributions of IIT and NT to TT growth reflects our concern with adjustment problems associated with trade growth and liberalization. For looking at such problems, we need industry categories that have the following property. They should be defined so that the cost of intra-industry factor movements is low relative to inter-industry movements. This means that the categories must be neither too fine nor too broad. With very fine categories, there will be inter-industry factor movements which are barely more costly than intra-industry movements. With categories which are too broad, intra-industry movements may be just as costly as inter-industry movements ⟨Dixon and Menon [1995]⟩.

With these considerations in mind, 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). Activities within such industries tend to have similar capital and skill requirements. Furthermore, it is often true that each firm produces the full range of the industry's products. For example, chemical firms usually produce most types of inorganic acids. Thus it is reasonable to assume that factor re-allocations within 3-digit industries are relatively cheap. On the other hand, movements of factors between industries such as inorganic acids, paints etc. are likely to be quite costly. Consequently, we worked with data at this level covering 130 manufacturing industries belonging to SITC 5-8 less 67-68 (metals). The data relate to the calender years 1981, 1986 and 1991, and come from the UN's COMTRADE data base.

V. Results

The results of computations of various contribution measures are presented in Tables 1 to 4. While the computations are carried out using data for the 130 manufacturing industries, the tables contain various aggregations of our results.[10] The aggregation formulas are in the notes at the end of the tables.

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10. The detailed results for the 130 industries are available on request.

Table 1
Contributions Measures and GL Indexes for Australia-New Zealand Trade, 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:

$$TT(g)_{jk} = \Sigma_{i \in s(g)} \, TT_{ijk} \qquad (1)$$
$$NT(g)_{jk} = \Sigma_{i \in s(g)} \, NT_{ijk} \qquad (2)$$
$$IIT(g)_{jk} = \Sigma_{i \in s(g)} \, IIT_{ijk} \qquad (3)$$
$$GL(g)_{jk} = \Sigma_{i \in s(g)} \, GL_{ijk}(TT_{ijk}/(TT(g)_{jk}) \qquad (4)$$

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

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

$$nt(g)_{jk} = \Sigma_{i \in s(g)} \, nt_{ijk}(NT_{ijk}/(NT(g)_{jk}) \qquad (6)$$
$$iit(g)_{jk} = \Sigma_{i \in s(g)} \, iit_{ijk}(IIT_{ijk}/(IIT(g)_{jk}) \qquad (7)$$
$$Cnt(g)_{jk} = (1 - GL(g)_{jk}) nt(g)_{jk} \qquad (8)$$
$$Ciit(g)_{jk} = GL(g)_{jk} \, iit(g)_{jk} \qquad (9)$$
$$Cmtt(g)_{jk} = \Sigma_{i \in s(g)} \, Cmtt_{ijk}(TT_{ijk}/TT(g)_{jk}) \qquad (10)$$
$$Cxtt(g)_{jk} = \Sigma_{i \in s(g)} \, Cxtt_{ijk}(TT_{ijk}/TT(g)_{jk}) \qquad (11)$$
$$Cmnt(g)_{jk} = \Sigma_{i \in s(g)} \, Cmnt_{ijk}(NT_{ijk}/NT(g)_{jk}) \qquad (12)$$
$$Cxnt(g)_{jk} = \Sigma_{i \in s(g)} \, Cxnt_{ijk}(NT_{ijk}/NT(g)_{jk}) \qquad (13)$$
$$Cmiit(g)_{jk} = \Sigma_{i \in s(g)} \, Cmiit_{ijk}(IIT_{ijk}/(IIT(g)_{jk}) \qquad (14)$$
$$Cxiit(g)_{jk} = \Sigma_{i \in s(g)} \, Cxiit_{ijk}(IIT_{ijk}/(IIT(g)_{jk}) \qquad (15)$$

A. Contributions of Growth in NT and IIT to the Growth in TT

Table 1 contains contributions of growth in NT and IIT to the growth in TT for Australia's trade with New Zealand.[11] The results presented in Table 1 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 IIT; the contribution of NT is negative. The negative contribution of NT has the effect of reducing growth in TT from 8.47 percent (the contribution of IIT) to 4.61 percent. 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 characterized by very strong growth in trans-Tasman trade. The growth in TT of total manufacturing of 97.12 percent is a result of 54.79 percent contribution from IIT and 42.32 percent contribution from NT. 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).

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

Table 2 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.

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11. The contributions of NT and IIT to the growth in TT are the same for Australia-New Zealand and New Zealand-Australia trade.

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 III 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 3 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

Table 2

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 3

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 (0.84)	16.19 (-0.01)	1.78 (-2.73)	-10.11 (0.03)
	86-91	2.25 (-3.41)	47.02 (0.00)	14.16 (15.42)	136.17 (0.00)

Source	Period	$Cnt(g)_{NA}$	$Cnt(g)_{NR}$	$Ciit(g)_{NA}$	$Ciit(g)_{NR}$
New Zealand	81-86	-0.61 (-2.08)	26.23 (0.27)	4.51 (6.70)	13.60 (-0.86)
	86-91	8.52 (-0.52)	28.79 (-1.28)	34.01 (1.66)	34.82 (4.08)

Notes: 1. Figures in parentheses represent the bias in the uncorrected contribution measures.

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.

The large number of Australian industries that are net exporters to New Zealand but net importers from the rest of the world could reflect trade diversion (which is not uncommon in a small RTA involving relatively similar countries such as the ANZCERTA). That is, in the absence of preferential tariffs that make imports from Australia more attractive than from outside the region, New Zealand would presumably procure her imports from the same countries outside the region that Australia purchases from. An interesting implication of this is that trade diversion contributes to a country's intra-industry trade. This is in contrast with previous studies on IIT in the EC that have identified IIT as part of trade creation (see Greenaway, 1982).

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

Table 4[1]

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

Notes: 1. Note that for Australia's trade, $\{M_{iAN} > X_{iAN}, M_{iAR} < X_{iAR}\} = \{M_{iAW} > X_{iAW}, M_{iAN} < X_{iAN}\} + \{M_{iAW} < X_{iAW}, M_{iAN} > X_{iAN}\}$; i.e. the sum of the first and fourth columns of results. Similarly, $\{M_{iAN} < X_{iAN}, M_{iAR} > X_{iAR}\} = \{M_{iAW} > X_{iAW}, M_{iAN} > X_{iAN}\} + \{M_{iAW} < X_{iAW}, M_{iAR} > X_{iAR}\}$; i.e. the sum of the second and third columns of results. The case for New Zealand's trade is symmetrical.

total of 130) were net importers from the world but net exporters to Australia. In other words, New Zealand is also able to gain quite substantially from trade diversion as a result of the ANZCERTA, but not as great as Australia's gain. There are also 7 industries that were net exporters to the world but net importers with respect to extra RTA trade.[12] These factors would account for 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.

VI. Concluding Remarks

Empirical work on IIT is almost 30 years old. From the earliest analysis 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 analyzing 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 showed how to measure 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

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

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 even more substantial. While intra RTA trade contributed 16.88 percent to 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. These opposite signed imbalances emerge mainly as a result of trade diversion within ANZCERTA. This trade diversion is reflected as a contribution to intra-industry trade.

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