Appendix A

Status-Switches

As mentioned in Chapter 3, the formulae for decomposing NT_i and IIT_i into the contributions of import and export growth (i.e. equations (14) through (19) in Chapter 3) 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*. In this appendix, status switches are considered in more detail. Status switches take place for net import industries ($M_i > X_i$) if and only if:

$$m_i \quad < \quad ((X_i / M_i) - 1) \quad + \quad (X_i / M_i)\, x_i. \qquad (1)$$

Status switches take place for net export industries ($X_i > M_i$) if and only if:

$$x_i \quad < \quad ((M_i / X_i) - 1) \quad + \quad (M_i / X_i)\, m_i. \qquad (2)$$

The shaded area above the line AB in Figure 1 shows the combinations of growth rates in M_i and X_i for which there is no status switch, while the unshaded area below the line shows combinations for which there is a status switch. Similarly, if we assume that X_i is initially greater than M_i, 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.

Almost all industries in our empirical analysis of ASEAN's manufacturing trade reported in Chapter 4 did not undergo status-switches between either ends of our two sub-periods. Thus, the overwhelming majority of cases fell in the shaded areas in Figures 1 and 2, so that $Cmnt_i$, $Cxnt_i$, $Cmiit_i$ and $Cxiit_i$ calculated via equations (16) through (19) are legitimate contribution measures. Notice that the shaded areas contain the (0, 0) combination. Thus, for no-switch cases, contributions calculated via equations (16) through (19) give the effects on growth in NT_i and IIT_i of reducing either m_i or x_i to zero.

In the case where the status of a product switches from a net import to a net export or *vice versa*, we find that:

FIGURE A1

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

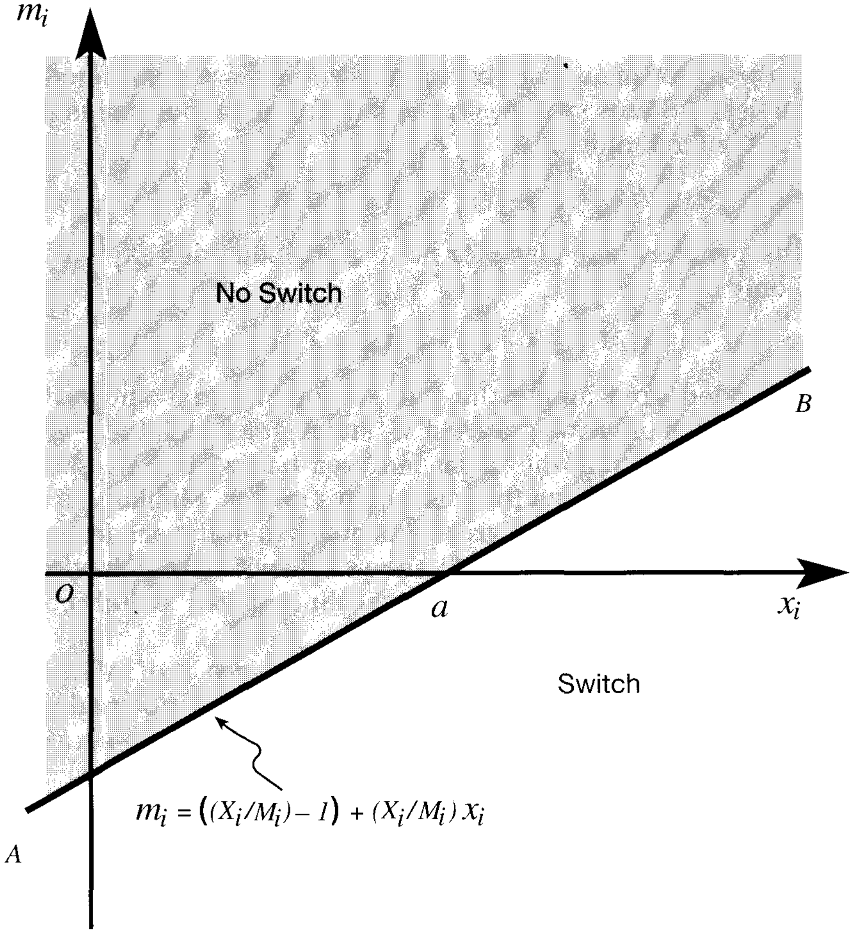
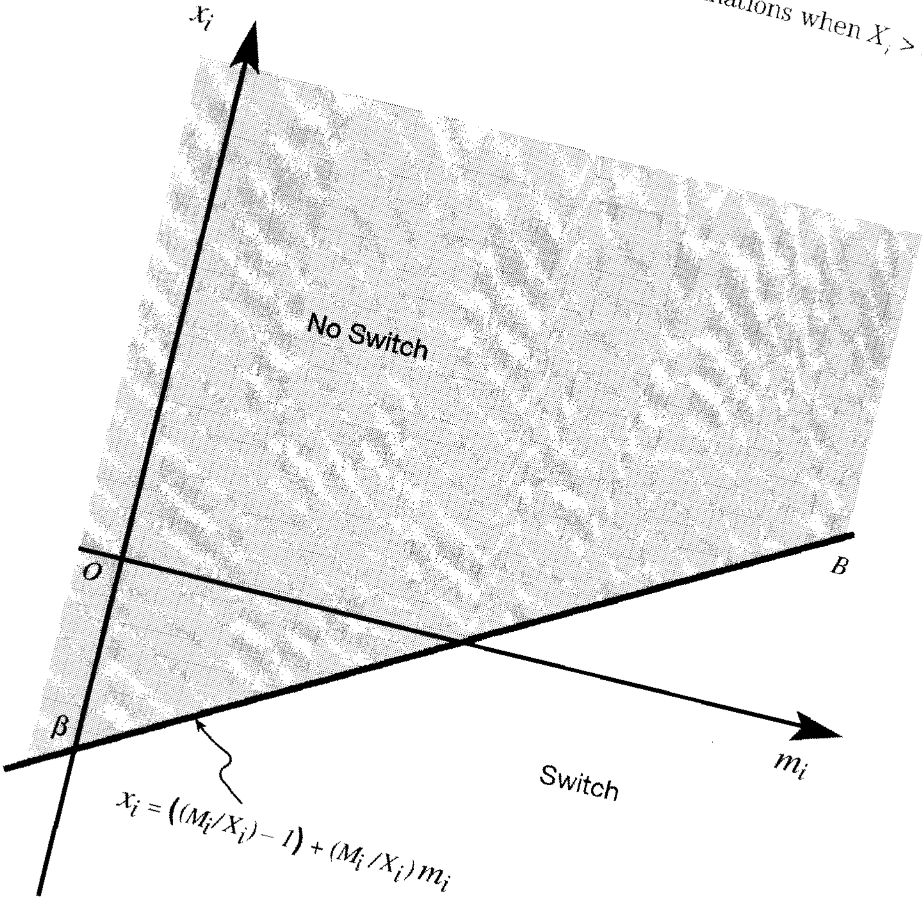


FIGURE A2

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



$$nt_i = -2 + (M_i / (X_i - M_i))\, m_i + (X_i / (M_i - X_i))\, x_i \qquad (3)$$

and

$$iit_i = ((M_i / X_i) - 1) + (M_i / X_i)\, m_i, \text{ for } M_i > X_i \text{ initially}, \qquad (4)$$

or

$$iit_i = ((X_i / M_i) - 1) + (X_i / M_i)\, x_i, \text{ for } X_i > M_i \text{ initially}. \qquad (5)$$

On the basis of these formulas, it is tempting to consider $(M_i/(X_i - M_i))\, m_i$ as the contribution of import growth to growth in NT_i; $(X_i/(M_i - X_i)\, x_i$ as the contribution of export growth to NT_i; etc. However, $(M_i/(X_i - M_i))\, m_i$, for instance, will not normally be the effect on growth of NT_i of reducing m_i to zero. In terms of our figures, we are dealing with $x_i - m_i$ combinations below the AB lines. Moving m_i from its observed level to zero will, very often, involve crossing the AB line. Once we cross this line, equations (21) through (23) are no longer valid. That is, in Figure 1, we will cross the AB line if $x_i > \alpha$. In Figure 2, we will cross the AB line if $x_i > \beta$.

As stated in Chapter 3, there is no solution to the problem of computing import and export contributions to growth in NT_i and IIT_i. For variations in $x_i - m_i$ combinations over our range of interest (including the (0, 0) combination), the effect of import growth on NT_i or IIT_i depends on the extent of export growth. Similarly, the effect of export growth on NT_i and IIT_i depends on the extent of import growth.

Appendix B

Categorical Aggregation and the Measurement of Intra-industry Trade

As discussed in Chapter 3, perhaps the most controversial issue in the measurement of IIT relates to the definition of "industry" employed in compiling the data base. 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 "categorical aggregation". In this appendix, we provide a systematic analysis of this potential problem by identifying its sources and quantifying its effect on the measurement of IIT.

Categorical aggregation has two conceptually distinct components, which we will call "product misclassification" and "aggregation bias". Finger (1975), Lipsey (1976) and Rayment (1976) emphasise the product misclassification aspect, arguing that the problem lies with trade data classification systems which group data within heterogeneous categories. To rectify this problem, they suggest regrouping the basic data such that the resulting categories conform more closely to the theoretical construct of an industry.

The definition of an "industry" with respect to product homogeneity is still under dispute, however (Lloyd 1989). For instance, Finger (1975) defines an industry as one where the products produced are similar with respect to their factor intensities. Falvey (1981), on the other hand, concentrates on the specificity of factors and defines an industry by the range of products that a certain type of capital equipment can produce. While these definitions concentrate on the production side, Lancaster's (1980) definition focuses on consumption: "a product class in which all products, actual and potential, possess the same characteristics, different products within the group being defined as products having these characteristics in different proportions" (p. 153).

It is clear from the discussion above that there is no unique criteria for regrouping the data. Furthermore, none of these definitions deal adequately with the problem of how to allocate trade in parts and components in any reclassified scheme. All in all, it is unclear if the arduous task of regrouping would yield any improvement upon established trade classification systems.

The aggregation bias aspect of categorical aggregation deals with the *level* of disaggregation at which the analysis is conducted within a *given* classification system. Aggregation bias occurs if sub-group or component industries at a lower level of disaggregation have offsetting trade imbalances, i.e. if sub-group trade imbalances have opposite signs (see Greenaway and Milner, 1983). To illustrate, consider, for instance, an industry defined at the 3-digit level of the SITC which is composed of two industries (a and b) at the 4-digit level. That is:

$$X_i = X_a + X_b \quad (1)$$
$$M_i = M_a + M_b \quad (2)$$

If $M_i > X_i$, and $M_a > X_a$, $M_b > X_b$, then

$$IIT_i = 2X_i \quad (3)$$
$$= 2X_a + 2X_b \quad (4)$$
$$= IIT_a + IIT_b \quad (5)$$

Equations (3) to (5) show that in the absence of opposite-signed imbalances, IIT measured at the 3-digit level is simply the sum of IIT measured at the 4-digit level. In this instance, our measure of the contribution of IIT growth to TT growth (**C*iit***) is:

$$\mathbf{Ciit}_i = (2X_i/TT_i)\, x_i \quad (6)$$
$$= (2X_a/TT_i)\, x_a + (2X_b/TT_i)\, x_b \quad (7)$$
$$= (TT_a/TT_i)\, \mathbf{Ciit}_a + (TT_b/TT_i)\, \mathbf{Ciit}_b \quad (8)$$

Equations (6) through (8) show that, if component imbalances are not oppositely signed, aggregating from the 4-digit level to the 3-digit level does not affect the value of our contribution measures. This is because, as shown in equation (8), our contribution measure computed with data at the 3-digit level is a simple trade weighted average of the contribution measures computed at the 4-digit level. In other words, there is no real advantage of working with data at the 4-digit rather than the 3-digit level in this instance.

Now we consider the effects of opposite-signed imbalances at a lower level of disaggregation. If $M_i > X_i$, but $M_a > X_a$, $M_b < X_b$, then our contribution measure computed with data aggregated at the 3-digit level will *overstate* the contribution of IIT to total trade growth. That is,

$$\mathbf{Ciit}_i \quad > \quad (TT_a/TT_i)\,\mathbf{Ciit}_a \quad + \quad (TT_b/TT_i)\,\mathbf{Ciit}_b \qquad (9)$$

We can quantify the extent of the aggregation bias at the 3-digit level. In this instance, the contribution measure obtained by working with data defined at the 4-digit level is:

$$\mathbf{Ciit}_i = \underbrace{(2X_i/TT_i)\,x_i}_{\text{Contribution computed at the 3-digit level}} \; - \; \underbrace{\{(2X_b/TT_i)\,x_b - (2M_b/TT_i)\,m_b\}}_{\text{Aggregation bias from offsetting imbalances at the 4-digit level}} \qquad (10)$$

Similarly, the GL index obtained by working with data defined at the 4-digit level in this instance will also involve a bias:

$$GL_i = \{(2(X_a + M_b))/(X_i + M_i)\}100 \qquad (11)$$

$$= \{\underbrace{[(2(X_a + M_b))/(X_i + M_i)]}_{\text{GL index computed at the 3-digit level}} - \underbrace{[(2(X_b - M_b))/(X_i + M_i)]}_{\text{Aggregation bias from offsetting imbalances at the 4-digit level}}\}100 \qquad (12)$$

(Proofs of these results are available from the author on request.)

It is clear that the level of disaggregation of the data should be chosen so as to minimize aggregation bias. In our study of ASEAN trade, we found that the 3-digit level of the SITC is sufficiently disaggregated to overcome the problem of aggregation bias in the overwhelming majority of industries. For all of the ASEAN countries, we found that only a small share of industries defined at the 3-digit level of the SITC contained opposite-signed imbalances at the 4-digit level. Of course, this does not preclude the possibility that opposite-signed imbalances may re-emerge at a lower level of disaggregation for these or any of the other industries. In fact, if one were to persist, it is almost certain that they would re-emerge at some point. It is also true that if one were to keep disaggregating *ad infinitum*, any measured IIT would also eventually disappear.

The problem with this, as discussed in Chapter 3, is that extending the disaggregation beyond the 3-digit level may exceed the bounds placed on any reasonable notion of an industry. This point is particularly important given our interest in adjustment costs associated with trade expansion. Given this interest, the disaggregation of the data should be broad enough to accommodate some degree of factor mobility *between* activities *within* each industry, while at the same time minimizing aggregation bias. We believe that disaggregation at the 3-digit level of the SITC comes closest to matching these competing demands on the definition of an "industry".

Appendix C

Sectoral Aggregation of Contribution Measures

This Appendix presents the aggregation formulas. In all the formulas below, the *s(j)*'s are sets of industries. That is, they refer to industries grouped at either the total manufacturing level, SITC 1-digit sectors, or groupings based on the import-export orientation of industries (i.e. either net import or net export).

To obtain these sectoral aggregates, we begin by defining the following:

$$TT(j) = \sum_{i \in s(j)} TT_i \quad (1)$$

$$NT(j) = \sum_{i \in s(j)} NT_i \quad (2)$$

$$IIT(j) = \sum_{i \in s(j)} IIT_i \quad (3)$$

$$GL(j) = \sum_{i \in s(j)} GL_i \, (TT_i \,/\, (TT(j)) \quad (4)$$

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

$$tt(j) = \sum_{i \in s(j)} tt_i \, (TT_i \,/\, TT(j)) \quad (5)$$

$$nt(j) = \sum_{i \in s(j)} nt_i \, (NT_i \,/\, (NT(j)) \quad (6)$$

$$iit(j) = \sum_{i \in s(j)} iit_i \, (IIT_i \,/\, (IIT(j)) \quad (7)$$

$$Cnt(j) = (1 - GL(j)) \, nt(j) \quad (8)$$

$$Ciit(j) = GL(j) \, iit(j) \quad (9)$$

$$Cmtt(j) = \sum_{i \in s(j)} Cmtt_i \, (TT_i \,/\, TT(j)) \quad (10)$$

$$Cxtt(j) = \sum_{i \in s(j)} Cxtt_i \, (TT_i \,/\, TT(j)) \quad (11)$$

$$Cmnt(j) = \sum_{i \in s(j)} Cmnt_i \, (NT_i \,/\, (NT(j)) \quad (12)$$

$$Cxnt(j) = \sum_{i \in s(j)} Cxnt_i \, (NT_i \,/\, (NT(j)) \quad (13)$$

$$Cmiit(j) = \sum_{i \in s(j)} Cmiit_i \, (IIT_i \,/\, (IIT(j)) \quad (14)$$

$$Cxiit(j) = \sum_{i \in s(j)} Cxiit_i \, (IIT_i \,/\, (IIT(j)) \quad (15)$$

Note that in equations (12) through (15), cases where a status switch occurs are excluded.