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Sharing the Gains from Common Markets among Developing Countries, with Reference to East Africa

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SHARING THE GAINS FROM COMMON MARKETS
AMONG DEVELOPING COUNTRIES,
WITH REFERENCE TO EAST AFRICA

by

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ABSTRACT

The problem of finding a mutually acceptable distribution of the gains from a common market is analyzed using n-person game theory. Using standard concepts of trade creation and trade diversion to measure the gains from cooperation, we apply this measure to 1963 data for the East African Common Market. The actual distribution of gains is found to be outside the core; it is contrasted with core imputations such as the Shapley value and the kernel. The near-dissolution of the East African Common Market in the mid-60's and the 1967 Treaty for East African Cooperation are briefly discussed.
I. INTRODUCTION

Finding a mutually acceptable distribution of the gains from a common market is probably the main barrier to economic integration among developing countries, and the main cause of friction within existing common markets. In this paper we consider the problem using n-person, "cooperative" game theory, with the East African Common Market (EACM) as an example. Such an approach provides a convenient framework for clarifying the issues at hand, for understanding the "bargaining power" of each country, and for specifying mutually acceptable distributions of the gains from cooperation.

The extent of benefits resulting from the EACM and the distribution of these benefits have been much debated within the EACM and in the literature. There is a general consensus that the region as a whole has benefited but the distribution of benefits has been uneven, with Kenya (K) having gained the most and Tanzania (T) the least. There is

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1. The work done by Segal (1970) attracted our attention to this problem. This paper differs from his in its measure of the benefits of cooperation; we also use some additional game theoretic concepts.

2. A slightly different problem in sharing the gains from cooperation is treated in Gately (1972).

3. Most of the literature is surveyed in Robson (1968, pp.126 - 169). His discussion is very helpful in clarifying the issues at hand and the assumptions made by each author.

4. Tanzania was formed in 1965 by the political union of Tanganyika and Zanzibar. Since the latter did not enter the EACM until 1967, data prior to that year refers to Tanganyika only.
no agreement, however, about whether Tanzania and perhaps Uganda (U) have suffered a net loss and would benefit by dropping out. The controversy reached a critical point in the mid-1960's, threatening the dissolution of the EACM; a compromise solution was agreed upon in the (1967) Treaty for East African Cooperation, which gave Tanzania and, to a lesser degree, Uganda more favorable positions.

In Section II we discuss briefly some of the game theoretic concepts employed: the alternative coalitions and coalition structures, the characteristic function, imputations and the core. In Section III we outline a measure of the (short-term) gains from cooperation and non-cooperation. With EACM data for 1963, we use this measure to make some illustrative estimates of the extent and distribution of the gains. In Section IV we utilize these estimates to help understand some of the decisions taken by the three countries during the period 1964 – 1967, namely the partial breakup of the Common Market in 1964/65 and its partial re-establishment in 1967 under the Treaty for East African Cooperation.

5. The references on game theory are Luce and Raiffa (1957) and Rapoport (1970).

6. While the longer-term effects are also important in a satisfactory policy recommendation, we confine our attention to the focus of most of the literature, the short-term effects of cooperation and non-cooperation.
II. THE GAME THEORETIC FRAMEWORK

Previous discussions, with the exception of Segal (1970), have considered only two alternatives, the (three-country) EACM versus three separate national markets. There are, however, five alternative ways of grouping the three countries together:

(K, U, T)  the three-country Common Market
(K, U), (T) Kenya and Uganda in a two-country Common Market, with Tanzania outside
(K, T), (U) Kenya and Tanzania in a two-country Common Market, with Uganda outside
(U, T), (K) Uganda and Tanzania in a two-country Common Market, with Kenya outside
(K), (U), (T) no Common Market at all.

Consideration of all five possibilities (coalition structures) is necessary for an understanding of bargaining among the three countries.

Presuming that we have some acceptable measure of the gains from cooperation and non-cooperation (Section III), we summarize this information in the game's characteristic function. For each of the seven coalitions ((K, U, T), (K, U), (K, T), (U, T), (K), (U), (T)), the characteristic function value, denoted by \( v \) (coalition), is the total of gains to be shared by the members of that coalition.
The benefits received by each of the three countries will be denoted $X_K$, $X_U$, $X_T$ respectively. The first condition for a distribution of gains to be mutually acceptable is that it satisfy individual rationality: each country should receive an amount at least as great as what it could achieve by not cooperating:

\[ X_K \geq v(K) \]
\[ X_U \geq v(U) \]
\[ X_T \geq v(T). \]

(1)

If any of these inequalities in (1) does not hold, then that country would be better off outside the EACM. 7

Another condition we might want to specify as necessary for a mutually acceptable distribution is group rationality for the three countries taken together; however the gains are divided, the total gains possible should be disbursed:

\[ X_K + X_U + X_T = v(K, U, T). \]

(2)

---

7. Note that these conditions are not the same as specifying positive gains to each country, i.e. $X_i \geq 0$. This point is made by Robson (1968, p.134) in a slightly different context, discussing the study of Brown (1961): "The conclusion it supports, however, is that, given the common market, the income generated by Kenya's extra imports from the rest of the common market compensates Tanzania and Uganda for their purchases from Kenya at more than world prices. The conclusion is not warranted that Tanzania and Uganda gain rather than lose from the common market in the sense that they would lose by withdrawal".
(Any distribution satisfying conditions (1) and (2) is called an imputation.) Acceptance of this second condition presumes that compensating monetary side payments (having the property of transferable utility) are possible and/or the transfer of industries between countries does not increase or decrease the gains from those industries: Relaxation of these assumptions will be considered briefly in Section IV.

Still another condition might be imposed, that any pair of countries jointly receives an amount no less than what they could achieve without the cooperation of the third:

\[
\begin{align*}
X_K + X_U & \geq v(K,U) \\
X_K + X_T & \geq v(K,T) \\
X_U + X_T & \geq v(U,T).
\end{align*}
\]

If one of these inequalities is not satisfied, then those two countries could both gain by refusing to cooperate with the third. All those distributions which satisfy conditions (1), (2), and (3) constitute the core. Equivalently, the core consists of those distributions satisfying conditions (2) and

\[
\begin{align*}
v(K) & \leq X_K \leq v(K,U,T) - v(U,T) \\
v(U) & \leq X_U \leq v(K,U,T) - v(K,T) \\
v(T) & \leq X_T \leq v(K,U,T) - v(K,U).
\end{align*}
\]
One measure of the bargaining power of country $i$ could be the amount it is guaranteed within the core, on the left side of the inequalities in (4). Another measure would be the maximum it could achieve within the core, on the right side of the inequalities in (4).

Still another measure of a country's relative bargaining power is its propensity to disrupt the three-country agreement; for any proposed imputation, a country's propensity to disrupt is the ratio of how much the other two countries would lose to how much it would lose if it refused to agree and became self-sufficient:

$$P_K = \frac{X_U + X_T - v(U,T)}{\max (0, X_K - v(K))}$$

$$P_{U} = \frac{X_K + X_T - v(K,T)}{\max (0, X_U - v(U))}$$

$$P_{T} = \frac{X_K + X_U - v(K,U)}{\max (0, X_T - v(T))} .$$

8. The term is from Gately (1972). To our knowledge of the game theory literature, the concept was first discussed there, although Alan Manne has noted, in private correspondence, its similarity with "damage exchange ratios" in geopolitics.

9. In the original definition in Gately (1972), the propensity to disrupt was defined as

$$P_i = \frac{X_j + X_k - v(j,k)}{X_i}$$

This is equivalent to the definition in this paper for games in which $v(i) = 0$, as was the case in Gately (1972).
For any imputation not in the core at least one country, say T, would receive less than what it could achieve alone: \( X_T < v(T) \); the denominator would then be zero and it would have an infinitely high propensity to disrupt. For any imputation in the core where one country received only slight more than it could achieve alone, the denominator will be small (though positive) and its disruptive propensity would be very high. For any imputation where one country, say K, received more than its maximum in the core, the numerator and therefore the propensity to disrupt would be negative. Finally, the higher is one country's propensity to disrupt, the more willing the other two countries would be to increase its share in order to induce it to cooperate.

III. MEASURING THE BENEFITS OF COOPERATION AND NON-COOPERATION

Our measure of benefits employs the standard concepts of trade creation and trade diversion to evaluate the (short-term) effects of cooperation for all three countries and for each subset of countries. Aware of the data limitations, \(^{10}\) we make some simplifying assumptions

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10. According to Robson (1968, p.147), "No satisfactory estimates of the benefits and costs of the East African Common Market have yet been made, mainly because ... the cost and demand data necessary for adequate quantification are not available."
and rough estimates of these benefits so that we can proceed to
demonstrate the value of approaching the problem in a game theoretic
framework. Our first assumption is that each country's EACM exports\textsuperscript{11} can be divided into those which are independent of the existence of
the EACM arrangement and those which are, at least partly, dependent
upon it; further, a country's EACM-dependent exports can be divided
into two groups, trade creation exports and trade diversion exports.
(Many more assumptions are listed below: A1, \ldots, A10.)

First, the net gains resulting from the establishment of the
(three-country) EACM. The effects upon each country are assumed to
consist of the following:\textsuperscript{12}

1. the value added in trade creation exports to the other
two countries (a gain);

2. the value added in trade diversion exports to the
other two countries (a gain, to the exporting country);

3. the value added in production for domestic consumption
from EACM-dependent industries (a gain);

4. the added cost of its trade diversion imports from the
other two countries (a loss).

\textsuperscript{11} EACM exports (imports) refer to those goods traded among the
three countries, not those traded with fourth countries. Unless
clearly stated to the contrary, "exports" and "imports" will
refer to trade among the three countries.

\textsuperscript{12} This measure of the gains from cooperation differs from that of
Segal (1970). He assumed, in effect, that all EACM exports were trade
creation exports resulting from the establishment of the EACM. The
total gain was the value added in all EACM exports.
For each country, the algebraic sum of the gains and losses represents the actual net benefits it has received from the establishment of the EACM. The sum of these gains and losses for all three countries represents the total gains from cooperation, the characteristic function value $v(K,U,T)$.

Next, the net gains to the members in a two-country Common Market. The effects upon each of the two now reflect the departure of the third country (and the assumed tariff structure which the two-country Common Market and the third country adopt):

1. the value added in trade creation exports to partners in those EACM-dependent industries which survive the departure of the third country (see Assumption A10 below);

2. the value added in trade diversion exports to its partners in surviving EACM-dependent industries;

3. the value added in production for domestic consumption in surviving EACM-dependent industries (see Assumption A10);

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13. Strictly speaking, these are the effects of only the common market arrangements per se. Other transfer effects of the agreement could also be included, such as the sharing of costs and benefits of the Distributable Pool and the Common Services: see Robson (1968) and Hazlewood (1967).

14. One possibility would be to assume that the Common Market retains its common external tariff intact and the third country adopts the same tariff schedule on all its imports, from both the other two countries and from abroad. However, a proper evaluation of the maximum benefits possible requires that each coalition optimizes with respect to its tariff structure, which may require one quite different from the present external tariff.

15. Segal's measure of $v(i,j)$ was the value added in trade between the two countries.
4. the gains due to eliminating trade diversion imports from the third country (lower prices, tariff revenue for the government) minus the cost of trade diversion imports from its partner;

5. the value added in import substitution for those goods, previously EACM-dependent imports from the third country, which can be produced within the Common Market and either consumed in the producing country or exported to its partner (see Assumption A10).

The algebraic sum of these effects for each country would represent its net benefits from the two-country Common Market. The sum for both countries is the characteristic function value for that two-country coalition.

Finally, the net gains to a country which refuses to agree to any Common Market arrangements: 16

1. the value added in production for domestic consumption from surviving export industries (Assumption A9);

2. the gains from eliminating trade diversion imports;

3. the value added in import substitution for those former EACM-dependent imports which can be produced domestically (Assumption A9).

16. In Segal (1970), \( v(i) = 0 \).
The sum of these gains represents the benefits of non-cooperation, the characteristic function value for that one-country "coalition".

We now make a variety of assumptions, some plausible and some less so, to enable us to make the calculations necessary for the characteristic function values:

(A1) All resources involved in any of the category of gains and losses have zero opportunity cost: any domestic resources are assumed to have been previously unemployed and any foreign capital has only been attracted by the establishment of the EACM. 17

(A2) The percentage of a country's EACM exports which are independent of the EACM's existence is the same as the percentage of that country's EACM exports receiving no external tariff protection: 14% of Kenya's EACM exports 20% of Uganda's and 46% of Tanzania's. 18

(A3) Each country's EACM-dependent exports have the same percentage commodity composition as its total EACM exports. 19

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17. Our measure therefore provides an upper limit for these gains. When resource opportunity costs are positive, the actual gains would be smaller, by the amount of alternate production foregone. A similar assumption was made by Segal (1970).

18. Percentages calculated from 1962 data in Ndegwa (1968, p.100). Hazlewood (1966) has argued that these use of percentages would underestimate the proportion of EACM-independent exports since some EACM exports with a positive external tariff don't require this protection and would be competitive without it. We have difficulty reconciling this assertion with the fact that "unnecessary" external tariffs on certain products cited by Hazlewood (beer, cigarettes) were, for some reason, raised between 1958 and 1963 (Ndegwa (1968, p.101)). Even granting his assertion, however, it does not follow that a non-cooperating country couldn't restrict imports of such items by tariffs or quotas; see Robson (1968, p.48).

19. This assumption made necessary by lack of access to information about external duties on specific products.
(A4) Trade diversion exports consist of one-half a country's EACM-dependent manufactured exports, where "manufactures" consist of SITC categories 1, 5, 6, 7, 8 (72.5% for Kenya, 50% for Uganda, 36.7% for Tanzania). The remainder of EACM-dependent exports and all of its EACM-dependent "primary" exports (SITC 0, 2, 3, 4, 9) constitute its trade creation exports. 20

(A5) The percentage commodity composition of a country's EACM exports is the same to each of the other two countries.

(A6) The cost of trade diversion to the importing country is 20% of the value of the imports.

(A7) Value added as a proportion of total value is 65% for Kenya and Uganda and 45% for Tanzania. 21

(A8) In EACM-dependent industries, under the three-country EACM, production for domestic consumption equals production for EACM exports.

(A9) If one country refuses to cooperate then all its EACM-dependent exports will disappear. Domestic production in these EACM-dependent industries will be reduced to half its former value in the three-country EACM. It can import substitute for only a fraction of its former EACM-dependent imports: this fraction is .80 for Kenya, .50 for Uganda, and .40 for Tanzania.

(A10) If only one country refuses to cooperate the loss of that country's market will have an effect upon the survivability of the EACM-dependent exports between the other two countries. If K, U, or T is the one which drops out, then 30%, 70%, or 80%, respectively, of the EACM-dependent exports between the two countries in (U,T), (K,T), or (K,U), respectively, will survive. Production for domestic consumption will be at 70%, 80%, or 90%, respectively, of its former level in (U,T), (K,T), or (K,U) respectively. Import substitution in each country in the two-country Common Market will take place to the same degree as in A9: Kenya can import substitute for 80% of its EACM-dependent imports from the third country, Uganda 50%, and Tanzania 40%.

20. Assumption made necessary by lack of access to data on commodity composition by destination.

As will no doubt be obvious, many of these assumptions are quite arbitrary. They were made for the sake of convenience, to enable us to make back-of-the-envelope calculations of the benefits of cooperation and non-cooperation.

Listed in Table 1 are each country's EACM exports, by commodities, for 1963. Data for this year has been used in much of the debate in the literature, and we shall also use it as representative of the situation in the early 1960's. Using our assumptions, this data is broken down into some of the various categories which we require (Table 2).

An evaluation of the benefits is carried out for the case of the three-country Common Market in Table 3, for each of the three two-country Common Markets in Table 4, and for each non-cooperating country in Table 5. The characteristic function values, rounded to the nearest hundred thousand £, are summarized in Table 6.
Table 1

COMMODITY COMPOSITION FOR EACM EXPORTS, 1963*  
(in thousand £)

<table>
<thead>
<tr>
<th>SITC Number</th>
<th>Description</th>
<th>Kenya's EACM Exports (^b)</th>
<th>Proportion of its Total (^2)</th>
<th>Uganda's EACM Exports (^c)</th>
<th>Proportion of its Total (^4)</th>
<th>Tanzania's EACM Exports (^d)</th>
<th>Proportion of its Total (^6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>food</td>
<td>4,904</td>
<td>24.8%</td>
<td>2,738</td>
<td>33.2%</td>
<td>1,247</td>
<td>36.4%</td>
</tr>
<tr>
<td>1</td>
<td>beverages and tobacco</td>
<td>2,995</td>
<td>15.1%</td>
<td>1,419</td>
<td>17.2%</td>
<td>107</td>
<td>3.1%</td>
</tr>
<tr>
<td>2</td>
<td>crude materials</td>
<td>184</td>
<td>.9%</td>
<td>133</td>
<td>1.6%</td>
<td>590</td>
<td>17.2%</td>
</tr>
<tr>
<td>3</td>
<td>fuels</td>
<td>49</td>
<td>.3%</td>
<td>349</td>
<td>4.2%</td>
<td>38</td>
<td>1.1%</td>
</tr>
<tr>
<td>4</td>
<td>oils and fats</td>
<td>205</td>
<td>1.0%</td>
<td>901</td>
<td>10.9%</td>
<td>287</td>
<td>8.4%</td>
</tr>
<tr>
<td>5</td>
<td>chemicals</td>
<td>2,348</td>
<td>11.9%</td>
<td>331</td>
<td>4.0%</td>
<td>49</td>
<td>1.4%</td>
</tr>
<tr>
<td>6</td>
<td>manufactured goods</td>
<td>5,404</td>
<td>27.3%</td>
<td>2,280</td>
<td>27.7%</td>
<td>566</td>
<td>16.5%</td>
</tr>
<tr>
<td>7</td>
<td>machinery</td>
<td>179</td>
<td>.9%</td>
<td>20</td>
<td>.3%</td>
<td>6</td>
<td>.2%</td>
</tr>
<tr>
<td>8</td>
<td>miscellaneous manufactures</td>
<td>3,428</td>
<td>17.3%</td>
<td>66</td>
<td>.8%</td>
<td>526</td>
<td>15.5%</td>
</tr>
<tr>
<td>9</td>
<td>other</td>
<td>94</td>
<td>.5%</td>
<td>6</td>
<td>.1%</td>
<td>7</td>
<td>.2%</td>
</tr>
</tbody>
</table>

**TOTAL**                                                       | 19,790                        | 100%                          | 8,243                        | 100%                         | 3,423                        | 100%                         |

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* Taken from Ndegwa (1968, pp.58 - 63).

\(^b\) Of these, 47.6% go to Uganda, 52.4% to Tanzania (Ndegwa (1968, p.50)).

\(^c\) Of these, 75.8% go to Kenya, 24.2% to Tanzania (Ndegwa (1968, p.51)).

\(^d\) Of these, 85.2% go to Kenya, 14.8% to Uganda (Ndegwa (1968, p.51)).
<table>
<thead>
<tr>
<th></th>
<th>Kenya's E.A. Exports</th>
<th>Uganda's E.A. Exports</th>
<th>Tanzania's E.A. Exports</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(to U)</td>
<td>(to K)</td>
<td>(to T)</td>
</tr>
<tr>
<td>1. Total exports</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1a E.A.-independent exports</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1b E.A.-dependent manufactures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1c E.A.-dependent primary manufactures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Value added, trade diversion &amp; Euro generation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2a Value added</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2b Value added, trade diversion</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:

- a. Destination of a country's total exports (from Table 1) determined by footnotes b, c, d, e, f of Table 1.
- b. Calculated using (A2) and the amount from line 1b-1 and the percentages listed in (A4): e.g., 9400 = (0.725) (1320) (9400).
- c. Calculated as one half the amount on line 1b-1 and the amount on line 1b-2 (A4).
- d. The sum of one half the amount on line 1b-1 and the amount on line 1b-2 (A4).
- e. Calculated using the proportions from (A7): e.g., 1900 = (0.65) (2995).
Table 3
BENEFITS TO THE THREE-COUNTRY COMMON MARKET
(in thousand £)

<table>
<thead>
<tr>
<th></th>
<th>Gains (Losses) to Kenya</th>
<th>Gains (Losses) to Uganda</th>
<th>Gains (Losses) to Tanzania</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Value added, trade creation exports&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7055</td>
<td>3220</td>
<td>680</td>
</tr>
<tr>
<td>2. Value added, production for domestic consumption&lt;sup&gt;b&lt;/sup&gt;</td>
<td>11100</td>
<td>4280</td>
<td>830</td>
</tr>
<tr>
<td>3. Value added, trade diversion exports&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4000</td>
<td>1070</td>
<td>153</td>
</tr>
<tr>
<td>4. Loss from trade diversion imports&lt;sup&gt;d&lt;/sup&gt;</td>
<td>(308)</td>
<td>(605)</td>
<td>(727)</td>
</tr>
<tr>
<td>5. Net benefits to each country</td>
<td>21847</td>
<td>7965</td>
<td>936</td>
</tr>
<tr>
<td>6. Characteristic Function Value: v(K,U,T) = 30748</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> From Table 2, line 3.

<sup>b</sup> Using (A8) and the value added proportions from (A7); e.g., 11100 = (.65) (17115).

<sup>c</sup> From Table 2, line 2.

<sup>d</sup> From (A6), 20% of trade diversion imports from Table 2, line 1b-i; e.g., 308 = (.20) (1250 + 290).
Table 4

BENEFITS TO EACH OF THE THREE TWO-COUNTRY COMMON MARKETS

(in thousand £)

<table>
<thead>
<tr>
<th></th>
<th>(K,U)</th>
<th>(K,T)</th>
<th>(U,T)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gains (Losses) to K</td>
<td>Gains (Losses) to U</td>
<td>Gains (Losses) to K</td>
</tr>
<tr>
<td>1. Value added, trade creation exports(^a)</td>
<td>2840</td>
<td>1950</td>
<td>2590</td>
</tr>
<tr>
<td>2. Value added, production for domestic consumption (^b)</td>
<td>10000</td>
<td>3850</td>
<td>8900</td>
</tr>
<tr>
<td>3. Value added, trade diversion exports (^c)</td>
<td>1520</td>
<td>648</td>
<td>1470</td>
</tr>
<tr>
<td>4. Gains from reverse trade diversion minus loss from trade diversion imports (^d)</td>
<td>(192)</td>
<td>(575)</td>
<td>(156)</td>
</tr>
<tr>
<td>5. Value added, import substitution for previously EACM-dependent imports from third country (^e)</td>
<td>825</td>
<td>124</td>
<td>2600</td>
</tr>
<tr>
<td>6. Net benefits to each country</td>
<td>14993</td>
<td>5997</td>
<td>15560</td>
</tr>
<tr>
<td>7. Characteristic Function Value</td>
<td>(v(K,U) = 20990)</td>
<td>(v(K,T) = 17010)</td>
<td>(v(U,T) = 10283)</td>
</tr>
</tbody>
</table>

\(^a\) Calculated using proportions from (A10); e.g., 2840 = (.80)(3555), where .80 is from A10 and 3555 is from Table 1, line 3.

\(^b\) From A10, domestic production is only a fraction of its level; e.g., 10000 = (.9)(11100), where .9 is from A10 and 11100 from Table 3, line 2.

\(^c\) Calculated using A10 and Table 2, line 2; e.g., 1520 = (.8)(1900).

\(^d\) Calculated using A6, A10 and Table 2, line 1b-i; e.g., -192 = (.2)(290) - (.2)(.8)(1250), where .2 is from A6, .8 is from A10, 290 and 1250 from Table 2, line 1b-i.

\(^e\) Calculated using A10, A7, and Table 2, line 1b, e.g., 825 = (.8)(.65)(1578).
Table 5

**BENEFITS OF NON-COOPERATION FOR EACH COUNTRY**

*(in thousand £)*

<table>
<thead>
<tr>
<th></th>
<th>Gains to Kenya</th>
<th>Gains to Uganda</th>
<th>Gains to Tanzania</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Value added, production for domestic consumption(^a)</td>
<td>5550</td>
<td>2140</td>
<td>415</td>
</tr>
<tr>
<td>2. Gain from reverse trade diversion(^b)</td>
<td>308</td>
<td>605</td>
<td>727</td>
</tr>
<tr>
<td>3. Value added, import substitution for previously EACM-dependent imports from other two countries(^c)</td>
<td>3500</td>
<td>2700</td>
<td>1900</td>
</tr>
</tbody>
</table>

Net benefits = Characteristic Function Value

\[ v(K) = 9358 \quad v(U) = 5445 \quad v(T) = 3042 \]

\(^a\) Using A9, and Table 3, line 2; e.g., 5500 = (.5) (11100).

\(^b\) From Table 3, line 4.

\(^c\) Using A6, A9, and Table 2, line 1b; e.g., 3500 = (.65) (5000 + 1578).
Table 6

VALUES OF THE CHARACTERISTIC FUNCTION\textsuperscript{a}
(in thousand £)

<table>
<thead>
<tr>
<th>Coalition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(K,U,T)</td>
<td>$v(K,U,T) = 30,700$</td>
</tr>
<tr>
<td>(K,U)</td>
<td>$v(K,U) = 21,000$</td>
</tr>
<tr>
<td>(K,T)</td>
<td>$v(K,T) = 17,000$</td>
</tr>
<tr>
<td>(U,T)</td>
<td>$v(U,T) = 10,300$</td>
</tr>
<tr>
<td>(K)</td>
<td>$v(K) = 9,400$</td>
</tr>
<tr>
<td>(U)</td>
<td>$v(U) = 5,400$</td>
</tr>
<tr>
<td>(T)</td>
<td>$v(T) = 3,000$</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Values are taken from Tables 2,3,4 and rounded to the nearest hundred thousand £.
IV. ANALYZING THE DISTRIBUTION OF GAINS

Using our values for the characteristic function (Table 6), the core consists of those distributions \((X_K, X_U, X_T)\) of the total gains such that

\[ X_K + X_U + X_T = 30,7000 = v(K,U,T) \]  

(2')

and

\[ v(K) = 9,400 \leq X_K \leq 20,400 = v(K,U,T) - v(U,T) \]  

(4')

\[ v(U) = 5,400 \leq X_U \leq 13,700 = v(K,U,T) - v(K,T) \]

\[ v(T) = 3,000 \leq X_T \leq 9,700 = v(K,U,T) - v(K,U) \]

In the three-dimensional distribution space of Figure 1, the core is the hexagonal area \(^{22}\) ABCDEF on the triangle of imputations LMK. Also indicated in Figure 1 are the actual distribution of gains (point Z), the equal-shares-imputation (point W), the Shapley value (point S), and the kernel imputation (point Y).

22. The lines through the following pairs of points in Figure 1 are represented analytically as follows:

- **AB:** \( X_K = 9400, X_U + X_T = 21300 \)
- **BC:** \( X_U = 13700, X_K + X_T = 17000 \)
- **CD:** \( X_T = 3000, X_K + X_U = 27700 \)
- **DE:** \( X_K = 20400, X_U + X_T = 10300 \)
- **EF:** \( X_U = 5400, X_K + X_T = 25300 \)
- **AF:** \( X_T = 9700, X_K + X_U = 21000 \).
Figure 1

THE TRIANGLE OF IMPUTATIONS

The diagram illustrates the triangle of imputations with points labeled L, M, and N. The triangle is defined by the axes $X_T$ and $X_K$, with points 30700 on both axes. The equal-shares imputation is represented by a line segment connecting L and M. The Shapley value and kernel imputation are indicated by lines from M to points A, B, C, D, E, F, S, and Y. The actual distribution is shown by the line segment from N to Z.
The actual distribution of gains, calculated in Table 3, results in
\[ X_K = 21847, \quad X_U = 7965, \quad X_T = 936. \]

Since \( X_T < v(T) \), this distribution is not a member of the core: the net gains to Tanzania are not as large as it could achieve by non-cooperation. Hence Tanzania would have been better off dropping out of the EACM.\(^{23,24}\) Using the concept of the propensities to disrupt for this distribution, \( p_K \) would be negative, \( p_U \) between one and two, and \( p_T \) infinite. Given that sufficiently large compensation (in the form of a side payment) was not forthcoming, nor was there much hope of redistribution of industry within the EACM, Tanzania's unilateral action in 1965 to impose restrictions on many imports from Kenya and Uganda was therefore understandable. In effect it amounted to partial non-cooperation and a threat to total non-cooperation. Also understandable was the reluctance of all parties to have Tanzania drop out of the EACM entirely: Tanzania preferred to be within the EACM so that it could achieve gains greater than \( v(T) \), and both Kenya and Uganda wanted Tanzania's cooperation so the two of them could jointly achieve gains greater than \( v(K,U) \).

\(^{23}\) This conclusion would hold even taking account of the effects of the Distributable Pool, through which 485 thousand £ were transferred from Kenya to Uganda and 288 thousand £ from Kenya to Tanzania in 1962–63. (These are the larger of two sets of estimates by A. Hazlewood, as summarized in Robson (1968, p.114)).

\(^{24}\) The relevant comparison for settling this question is whether \( X_T > v(T) \), not whether \( X_T > 0 \); see footnote 7, in Section II.
Alternately, in the interests of "equity", one might propose that the total gains be divided equally among the three countries:

\[ X_K = 10233.3, \quad X_U = 10233.3, \quad X_T = 10233.3 \]

(point W in Figure 1). This distribution, however, is not a member of the core either because Kenya and Uganda jointly get less than what they could achieve without Tanzania; equivalently Tanzania gets an "unfairly" large share: \( X_T > v(K,U,T) - v(K,U) \). For this case both Kenya and Uganda have high propensities to disrupt, while Tanzania has a negative disruptive propensity.

Another distribution which might be proposed is the Shapley value:\(^{25}\)

\[ X_K = 14867, \quad X_U = 9516, \quad X_T = 6317 \]

(point S in Figure 1). Sometimes used as a benchmark of fairness, as in

---

25. The Shapley procedure assumes that three-country coalition is formed by some sequence such as country \( i \) joining the two-country coalition \( (j,k) \), which in turn was formed by country \( j \) joining the one-country coalition \( (k) \); there are six possible sequences, each assumed equally likely. It also assumes that the country joining the coalition receives the entire increment resulting from his joining. The Shapley value for country \( i \) is its expected final payment under this procedure:

\[
X_i = \frac{1}{6} \left[ (v(i,j,k) - v(j,k)) + v(i,i,k) - v(j,k) \\
+ (v(i,j) - v(j)) + (v(i,k) - v(k)) \\
+ (v(i)) + (v(i)) \right]
\]

See Luce and Raiffa (1957) or Rapoport (1970).
Segal (1970), this distribution is a member of the core; furthermore it equalizes the disruptive propensities of the three countries, at a value slightly larger than 1.

Still another distribution that could be proposed as a "normative" solution is the imputation in the kernel:

\[ X_K = 16033.3, \quad X_U = 9333.3, \quad X_T = 5333.3 \]

(point Y in Figure 1). As usual, this is less "egalitarian" than the Shapley value, which reflects the kernel's "hardheaded" approach to evaluating bargaining power as opposed to the Shapley procedure's notion

26. Interestingly, the Shapley value for Segal's characteristic function for 1963 (Segal (1970, p.130)) results in roughly the same percentage shares as ours: about one-fifth for Tanzania, one-third for Uganda, and the remainder for Kenya.

27. It's not always true that the Shapley value equalizes the propensities to disrupt: see Gately (1972).

28. There are other distributions in the kernel, one for each coalition structure, but this is the only imputation in the kernel.

29. This imputation has the property that each country is "in equilibrium" with every other country, i.e., where one country's maximum hope of gain by excluding the second country from a two-country coalition with the third equals the second country's maximum hope of gain by excluding the first from a two-country coalition with the third:

for K and U:
\[ \nu(K, T) - X_K - X_T = \nu(U, T) - X_U - X_T \]

for K and T:
\[ \nu(K, U) - X_K - X_U = \nu(U, T) - X_U - X_T \]

for U and T:
\[ \nu(K, U) - X_K - X_U = \nu(K, T) - X_K - X_T \]

See Rapoport (1970, Chapter 7) or the original article by Davis and Maschler (1965).
of a country's "hopes". 30 There are, however, difficulties of interpre-
tation for this kernel imputation. 31

To sum up so far, we have used the core to delineate those
imputations which would be mutually acceptable to the three countries.
We could further reduce this set by requiring that no country's disruptive
propensity be "too" high; this would eliminate core imputations "close"
to the perimeter of the core. Of those imputations suggested as
candidates for the "normative" solution, 32 the Shapley value would seem
the least objectionable. However, we would be reluctant to use it as
a benchmark of fairness or to say that, in any sense, it "ought" to
occur.

As mentioned in Section II, the search for a mutually
acceptable distribution need not be restricted to the set of imputations,
either because countries would be unwilling to make (or accept) monetary
side payments or because shifting industries between countries does not

30. See Rapoport (1970, p.113 and p.133) or Gately (1972) for a
discussion of the relative merits of the Shapley value and the
kernel imputation.

31. The maximum hope of gain for each country in the first equation
of footnote 29 is negative (they are positive in the other two
equations). Equating such negative quantities is therefore a
strange way of choosing the "normative" imputation.

32. Many other imputations might be suggested, e.g. weighting
each country's share of the total gains by its minimum [maximum]
in the core:

$$X_K = 16200, \ X_K = 9310, \ X_T = 5170$$

$$[X_K = 14300, \ X_K = 9600, \ X_T = 6800].$$
conserve the gains. One might argue that these countries were in fact willing to agree to side payments, given the way the Distributable Pool and the Common Services were operated. However, Tanzania's main demand in the 1960's was not for greater monetary compensation but for a greater share of industrial development. Similarly, the assumption that shifting industries conserves the gains is a questionable one. Since the choice of industrial location under laissez faire would be made to minimize the cost of production and distribution, higher costs would presumably be involved if the industry were to be located in a different country, resulting in smaller total gains to the EACM as a whole.

Such an alternative approach will not be considered in detail here, even though it might be helpful for a complete understanding of the agreement reached in the 1967 Treaty for East African Cooperation. This Treaty resolved the tensions of the mid-60's and averted the dissolution of the EACM. Based on the principle of each country having a "balance" in its EACM imports and exports of manufactures, it provided for a system of temporary "transfer taxes" (a euphemism for inter-country tariffs) on some manufactured exports from Kenya to Uganda and to Tanzania and from Uganda to Tanzania. This agreement presumably resulted in a mutually acceptable distribution but at the cost of reduced total gains.

33. See Robson (1968) and Hazlewood (1967).

34. For a survey of the theory of cooperative games without side payments, see Aumann (1967).
REFERENCES


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