AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523
BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY
Batch 67

1. SUBJECT CLASSIFICATION
A. PRIMARY
TEMPORARY
B. SECONDARY

2. TITLE AND SUBTITLE
Allocating integration industries in the Andean group

3. AUTHOR(S)
Schydlowsky,D.M.

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1971	17p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS
Harvard

8. SUPPLEMENTARY NOTES (Sponsoring Organization, Publishers, Availability)
(In Economic development rpt.no.175)

9. ABSTRACT
(ECONOMICS R&D)
(SCIENCE & TECHNOLOGY--INDUSTRIALIZATION R&D)

10. CONTROL NUMBER
PN-AAE-168

11. PRICE OF DOCUMENT

12. DESCRIPTORS

13. PROJECT NUMBER

14. CONTRACT NUMBER
CSD-1543 Res.

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

ALLOCATING INTEGRATION INDUSTRIES IN THE ANDEAN GROUP

by

Daniel M. Schydlowsky

Economic Development Report No. 175.

January 1971.

DEVELOPMENT ADVISORY SERVICE
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Portions of this research were supported by the Development Advisory Service through funds provided by Contract CSD-1543 from the Agency for International Development. The views expressed in this paper, however, do not necessarily reflect those of A.I.D.

SUMMARY

ALLOCATING INTEGRATION INDUSTRIES IN THE ANDEAN GROUP

The Andean Integration Group consisting of Colombia, Ecuador, Peru, Bolivia, and Chile has agreed to use as one of their policies of integration, the explicit allocation to each member of a number of so-called integration industries. This involves assigning virtual monopoly rights for the production of certain industrial commodities to the favored country. The assignment of industries to countries is to proceed on the basis of an agreed list of programmed industries.

The net benefits to the group as a whole from an integration industry consist of the present value of the foreign exchange saved or earned less the cost of the domestic resources taken at their social marginal cost converted at the marginal utility of foreign exchange. The net benefits to each member can be calculated in similar manner.

Each location for each industry will generate a particular group benefit and a specific distribution. The optimal location of a package of industries can be derived in a linear programming framework by maximizing group benefits subject to a penalty for inequality in distribution of per capita benefits.

Systems for sequential assignment of industries and for a separation of efficiency and distribution in the location decision can be created.

ALLOCATING INTEGRATION INDUSTRIES IN THE ANDEAN GROUP

The Andean Integration Group consisting of Colombia, Ecuador, Peru, Bolivia, and Chile has agreed to use as one of their policies of integration, the explicit allocation to each member of a number of so-called integration industries. This involves assigning virtual monopoly rights for the production of certain industrial commodities to the favored country. The assignment of industries to countries is to proceed on the basis of an agreed list of programmed industries.

The fundamental justification for any assignment of monopoly rights lies in the presumed existence of economies of scale. If such economies in fact characterize an integration industry, there is reason to believe that an outright allocation of monopoly rights will yield less costly import substitution (or indeed export production) than allocation through the market, since the latter implies the appearance of numerous smaller industries which would only gradually drive each other out of existence until the largest surviving one would be the only supplier in the market. In addition to this, it can be argued that if the industries are allocated "correctly", then the convergence process of the market mechanism will have been speeded up and the comparative advantage of the member countries will be given immediate expression with the consequent saving of real resources.

The benefits to be derived from the allocation of industries will depend rather crucially on the care with which the allocation is made, i.e., if the industries are allocated to the countries which are "most efficient" in the respective product, then presumably the gains to the union as a whole will be maximized. If industries are allocated to their worst producers, then the gains will be substantially less. The fundamental

questions, therefore, are (i) how to distribute the industries between member countries in order to maximize the gains to the union, and (ii) to distribute the benefits to be derived from the union in a "fair" manner. The answer to this question must begin with an identification of the benefits to the union as a whole and to each of the participants. Next it is necessary to have a criterion for distribution in order to be able to make the allocation in such a manner as to maximize the gain to the union subject to the distributional constraint. It should be noted that there is no reason to expect that the efficiency criterion will lead to an optimal distribution. Rather, it is likely that maximizing gains from the union will provide a skewed distribution of the benefits. In the absence of a device which can redistribute income among the members of the group, the distributional constraint will reduce the total efficiency with which the system operates.

Section II will attempt to quantify the benefits which the group as a whole derives from the establishment of integration industries. Section III will take up the question of distribution of the benefits, and Section IV will take up some problems of implementation.

II

The context in which integration industries are evaluated is one of sub-optimization within each sector. It has been decided a priori which industries are to be "programmed" and the question is how to extract the greatest possible benefit from the group-wide use of the markets thus reserved. The context, therefore, requires maximizing the present value of the production serving the reserved group markets.

The integration industries are all either pure import-substitution industries or import substituting ones with a dash of exporting to the rest of the world added in. In other words, the intent is to have group-wide import substitution and in some selected instances group-wide exports. This implies that the gross benefits of an Integration Industry consist of an amount of foreign exchange saved and/or earned. In order to produce this foreign exchange, moreover, it will be necessary to import some inputs from the rest of the world, and to use some material inputs produced in the group but which in the absence of the project would have been exported or which compete in turn with imports. Therefore, it is necessary to subtract from the gross foreign exchange saved or earned, the value of the material inputs which are internationally traded goods in order to arrive at a net benefit measured by the net foreign exchange saving or earning originating in the integration industry.

Furthermore, each industry will use a certain amount of primary factors of production, mainly domestic capital and labour. These factors have an opportunity cost, expressed in the currency of the country to which they belong, equal to the marginal cost to the rest of the respective economy of the factors used in the project. These marginal costs of the primary factors will naturally vary according to the country in which the integration industry is located. Each country likewise will have a marginal utility of foreign exchange arising out of the overall relationship between imports and domestic production and income in the respective economy. If the domestic resources used in the project are valued at their social marginal cost and translated into foreign exchange at the marginal utility of foreign exchange, the resulting amount measures the real cost

to the country concerned of having the factors of production used in the integration industry.

If we now subtract the domestic resource cost in foreign exchange from the net foreign exchange made available by the integration industry, we arrive at the net benefit of the industry for the group as a whole. Since these net benefits will be a stream of benefits across time, it will be necessary to discount them at the social time preference of the group as a whole to derive a net present value of the benefits.

It should be noted that whereas the gross benefits of foreign exchange savings or earnings are roughly independent of the location of the integration industry, since CIF and FOB prices are almost exactly the same for all the Andean countries, the same cannot be said of the costs of production. These will vary between different countries as a combined result of differences in the social marginal utility of foreign exchange, in the operating characteristics of the industry, and in the marginal social cost of factors of production.

Since each integration industry can be located in any one of the five countries, it has five potential contributions to the collective welfare. Performing the respective calculations for each one of the integration industries, we will have a number of possible total benefits from the integration industries equivalent to five times the number of industries involved. A three-country two-industry illustration is provided below.

Country	Industry	Widgets		Broomsticks
			Annual Market (In millions)	
Banania		US$ 50		US$ 30
Andinia		100		90
Latinia		90		20
Group		$240		$ 140
Common External Import Tariff		20%		25%
			Annual Cost (In millions)	
Banania		$200		$ 90
Andinia		180		80
Latinia		190		75

Annual Net Benefit Matrix

(In millions)

Country/Industry	Widgets	Broomsticks
Banania	$ 40	$ 50
Andinia	60	60
Latinia	50	65

Maximizing Solutions:

Widgets in Andinia	$ 60
Broomsticks in Latinia	65
Total Net Benefit	$ 135

III

Let us now examine the distributional implications of the allocations of integration industries.

Consider the consequences of allocating the widget industry to Andinia. The benefit of this industry to the group as a whole has been calculated in the previous section as equivalent to $60 million. If we

now calculate the benefit to Andinia, we must bear in mind that Andinia saves an amount of foreign exchange equivalent to its original imports of widgets and earns in addition foreign exchange equivalent to what the rest of the Andean group pays for the new widgets it produces. This total gross amount of foreign exchange earned by Andinia is greater than the total amount of foreign exchange saved by the group as a whole, since the partner countries pay Andinia a higher price for widgets than is charged by the international market. This is merely the expression of group-wide import substitution behind a uniform common tariff. If Andinia purchases the inputs into widgets from the rest of the world or from its own industry, it will have a materials cost in foreign exchange equivalent to the materials cost of the area as a whole.[1] Subtracting the foreign exchange cost from the gross foreign exchange availability, leaves a net amount of foreign exchange availability for Andinia. From this it is necessary to subtract the cost of Andinian factors of production. Discounting this time stream at Andinia's time preference gives the present value of the net benefit to Andinia from the widget industry.

Now let us look at Banania, where the widget industry is not located. This country finds itself purchasing widgets from Andinia at a higher price than it has to pay on the international market. Therefore, it has a net loss from the installation of the widget industry in Andinia. This net loss is equal to the difference between the price it pays for widgets

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1) If higher cost inputs are purchased from partner countries, Andinia's foreign exchange costs will be higher.

to Andinia and the price it pays to the rest of the world, discounted at Banania's social time preference.[2] The same is true of the third country.[3] The sum of the net benefits to Andinia and the net benefits to the other two countries, will be equal to the total net benefit to the group as a whole provided the three countries' social time preferences are equal.[4]

The sa .alculation can be undertaken for each of the possible locations[5] and programmed industries. The final result can be expressed in a matrix cross-tabulating location and industry by country. In our previous two commodity, three country example, the following result would be obtained:

Distribution of Annual Benefits of Widgets Production
(millions of dollars)

Producer/Benefits to	Andinia	Banania	Latinia	Group
Andinia	+88	-10	-18	60
Banania	-20	+78	-18	40
Latinia	-20	-10	+80	50

2) It is assumed that the price to the Banania's buyer remains unchanged; free inter-group trade allows Andinia to sell at the world cum tariff price.

3) If Banania or Latinia sell high cost widget inputs to Andinia, the distributorial impact will be lessened and could be reversed.

4) If the time preferences are different, the sum of the country benefits will only add up to the group benefits if the distribution of benefits of the particular industry considered is equal to the weight of each country's time preference in the group time preference.

5) Cf. Appendix I.

Distribution of Annual Benefits of Broomstick Production
(millions of dollars)

Producer/Benefits to	Andinia	Banania	Latinia	Group
Andinia	72.5	- 7.5	- 5	60
Banania	-22.5	77.5	- 5	50
Latinia	-22.5	- 7.5	95	65

Distribution of Annual Benefits of Integration Industries
(millions of dollars)

Producer/Benefits to	Andinia	Banania	Latinia	Group
Widgets/Broomstick				
Andinia/Andinia	+160.5	- 17.5	- 23	120
Andinia/Banania	65.5	67.5	- 23	110
Andinia/Latinia	65.5	- 17.5	77	125
Banania/Andinia	52.5	70.5	- 23	100
Banania/Banania	- 42.5	155.5	- 23	90
Banania/Latinia	- 42.5	70.5	77	105
Latinia/Andinia	52.5	- 17.5	75	110
Latinia/Banania	- 42.5	67.5	75	100
Latinia/Latinia	- 42.5	- 17.5	175	115

The matrix array presented above gives the technical possibilities of different allocation schemes the Andean group might adopt. It is now necessary to define a desired distribution in order to find the allocation that most closely approximates this objective function. Two allocation criteria come readily to mind: 1. Equal per capital benefit to each of the participating countries. 2. Equal weighted per capita benefit to each of the participating countries, with the weights being a function of per capita income.

The assignment of industries can now be put in a linear programming framework maximizing per capita benefits to the group as a whole with a penalty for unequal distribution subject to the constraint of the technical allocation possibilities. Specifically, the following formulation can be

used:

Maximize:

(1) $\Sigma_{ij} pc_i X_{ij} - \Sigma_j w_j d_j^{+} - \Sigma_j v_j d_j^{-}$

where pc_i - per capita benefits to the group of industry i

X_{ij} - activity level of industry i in country j

$d_j^{\pm}$ - deviation of country j's per capita benefits from distributionally unconstrained maximum average per capita group benefits from all integration industries

w_j, v_j - cost of deviations from average unconstrained per capita group benefits.

Subject to:

a) distributional constraints:

(2) $\Sigma_i pc_{ij} X_{ij} - d_j^{+} + d_j^{-} = PC$ $\quad$ j = 1, number of countries

where pc_{ij} - per capita benefits to country j of industry i

X_{ij} - activity level of industry i in country j

$d_j^{\pm}$ - positive and negative deviations

PC - distributionally unconstrained maximum per capita group benefits from all integration industries.

b) monopoly assignment constraints (i.e., production constraints)

(3) $\Sigma_j X_{ij} = 1$ $\quad$ i = 1, number of industries

It should be noted that if the assignment of programmed industries is to be used to correct for imbalances in the distribution of other benefits from integration; then the right hand side of the distributional constraint must be varied from PC by an amount equal to but opposite in signt to the deviation which should be compensated.[6]

It is worth noting that in general, the distributionally constrained allocation will imply an efficiency loss, since industries will not always be installed where they produce the highest benefit for the group as a whole. This efficiency loss could be avoided if an institutional framework could be derived which would permit income redistribution after the benefits from large scale production had been realized.

IV

The main implementation difficulty confronting the methodology outlined in the previous sections arises from the lack of project data. Indeed, without fairly complete project information on each of the integration industries (or products) a calculation of the kind described is impossible.

A possible solution to this problem lies in a sequential assignment procedure. Under this system, rather than assign all integration industries to member countries at one go, the assignment would take place as projects become available. For each project the contribution to the

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6) I owe this point to Mr. David Morawetz.

maximand (1) from different locations would be evaluated, and the locations chosen which would maximized the cumulated value of (1) over all projects assigned. Over time, then, the distributional implications would balance, albeit at a greater cost in efficiency than with a once and for all allocation.

Another solution consists of divorcing the efficiency and distributional aspects and postponing the actual assignments of products or industries, through the founding of an Andean holding company which would own one, several, or all of the integration industries. The industries could then be located according to the efficiency rule with the benefits, consisting of the profits plus the difference between cost at social and private prices of activating the industries, distributed in the form of dividends to the non-producing countries and in the form of factor payments and dividends to the country in which the respective industry is located. The system would function easily provided the share of the benefits accruing to any one country are larger than the difference between the market price and shadow price of the factors of production. If this condition does not hold, it would be necessary for the host country to pay to the Andean holding company a fee for the privilege of being a host country to integration industries, thus bringing its net benefits down to the share which corresponds to it.

V

In the previous sections, we have discussed the application of benefits-cost analysis to the problem of assigning integration industries

to individual countries in the Andean group. It appears that the present value of reserving markets can be maximized subject to a distributional constraint if information from investment projects is available. In its absence, a sequential allocation strategy or a divorce of efficiency and distribution seems desirable.

Appendix I

Distribution of Annual Net Benefits of Widget Production

Producer Andinia:

Andinia:	Foreign exchange saved:		$100
	Foreign exchange earned:		
	Banania	50+20%	60
	Latinia	90+20%	108
	Total		268
	Cost		180
	Net Benefit		88
Banania:	Foreign exchange lost	20% of 50	10
Latinia:	Foreign exchange lost	20% of 90	18
			28
	Group Benefits		60

Producer Banania:

Banania:	Foreign exchange saved:		$ 50
	Foreign exchange earned:		
	Andinia	100+20%	120
	Latinia	90+20%	108
	Total		278
	Cost		200
	Net Benefit		78
Andinia:	Foreign exchange lost	20% of 100	20
Latinia:	Foreign exchange lost	20% of 90	18
			38
	Group Benefits		40

Producer Latinia:

Latinia:	Foreign exchange saved:		$ 90
	Foreign exchange earned:		
	Banania	50+20%	60
	Andinia	100+20%	120
	Total		270
	Cost		190
	Net Benefit		80
Banania:	Foreign exchange lost	20% of 50	10
Andinia:	Foreign exchange lost	20% of 100	20
			30
	Group Benefits		50

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Annual Net Benefit Matrix

(In millions)

Country/Industry	Widgets	Broomsticks
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Andinia	60	60
Latinia	50	65

Maximizing Solutions:

Widgets in Andinia	$ 60
Broomsticks in Latinia	65
Total Net Benefit	$ 135

III

Let us now examine the distributional implications of the allocations of integration industries.

Consider the consequences of allocating the widget industry to Andinia. The benefit of this industry to the group as a whole has been calculated in the previous section as equivalent to $60 million. If we

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Latinia/Banania	- 42.5	67.5	75	100
Latinia/Latinia	- 42.5	- 17.5	175	115

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(1) $\Sigma_{ij} pc_i X_{ij} - \Sigma_j w_j d_j^{+} - \Sigma_j v_j d_j^{-}$

where pc_i - per capita benefits to the group of industry i

X_{ij} - activity level of industry i in country j

$d_j^{\pm}$ - deviation of country j's per capita benefits from distributionally unconstrained maximum average per capita group benefits from all integration industries

w_j, v_j - cost of deviations from average unconstrained per capita group benefits.

Subject to:

a) distributional constraints:

(2) $\Sigma_i pc_{ij} X_{ij} - d_j^{+} + d_j^{-} = PC$ $\quad j = 1$, number of countries

where pc_{ij} - per capita benefits to country j of industry i

X_{ij} - activity level of industry i in country j

$d_j^{\pm}$ - positive and negative deviations

PC - distributionally unconstrained maximum per capita group benefits from all integration industries.

b) monopoly assignment constraints (i.e., production constraints)

(3) $\Sigma_j X_{ij} = 1$ $\quad i = 1$, number of industries

It should be noted that if the assignment of programmed industries is to be used to correct for imbalances in the distribution of other benefits from integration; then the right hand side of the distributional constraint must be varied from PC by an amount equal to but opposite in signt to the deviation which should be compensated.[6]

It is worth noting that in general, the distributionally constrained allocation will imply an efficiency loss, since industries will not always be installed where they produce the highest benefit for the group as a whole. This efficiency loss could be avoided if an institutional framework could be derived which would permit income redistribution after the benefits from large scale production had been realized.

IV

The main implementation difficulty confronting the methodology outlined in the previous sections arises from the lack of project data. Indeed, without fairly complete project information on each of the integration industries (or products) a calculation of the kind described is impossible.

A possible solution to this problem lies in a sequential assignment procedure. Under this system, rather than assign all integration industries to member countries at one go, the assignment would take place as projects become available. For each project the contribution to the

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6) I owe this point to Mr. David Morawetz.

maximand (1) from different locations would be evaluated, and the locations chosen which would maximized the cumulated value of (1) over all projects assigned. Over time, then, the distributional implications would balance, albeit at a greater cost in efficiency than with a once and for all allocation.

Another solution consists of divorcing the efficiency and distributional aspects and postponing the actual assignments of products or industries, through the founding of an Andean holding company which would own one, several, or all of the integration industries. The industries could then be located according to the efficiency rule with the benefits, consisting of the profits plus the difference between cost at social and private prices of activating the industries, distributed in the form of dividends to the non-producing countries and in the form of factor payments and dividends to the country in which the respective industry is located. The system would function easily provided the share of the benefits accruing to any one country are larger than the difference between the market price and shadow price of the factors of production. If this condition does not hold, it would be necessary for the host country to pay to the Andean holding company a fee for the privilege of being a host country to integration industries, thus bringing its net benefits down to the share which corresponds to it.

V

In the previous sections, we have discussed the application of benefits-cost analysis to the problem of assigning integration industries

to individual countries in the Andean group. It appears that the present value of reserving markets can be maximized subject to a distributional constraint if information from investment projects is available. In its absence, a sequential allocation strategy or a divorce of efficiency and distribution seems desirable.

Appendix I

Distribution of Annual Net Benefits of Widget Production

Producer Andinia:

Andinia:	Foreign exchange saved:		$100
	Foreign exchange earned:		
	Banania	50+20%	60
	Latinia	90+20%	108
	Total		268
	Cost		180
	Net Benefit		88
Banania:	Foreign exchange lost	20% of 50	10
Latinia:	Foreign exchange lost	20% of 90	18
			28
	Group Benefits		60

Producer Banania:

Banania:	Foreign exchange saved:		$ 50
	Foreign exchange earned:		
	Andinia	100+20%	120
	Latinia	90+20%	108
	Total		278
	Cost		200
	Net Benefit		78
Andinia:	Foreign exchange lost	20% of 100	20
Latinia:	Foreign exchange lost	20% of 90	18
			38
	Group Benefits		40

Producer Latinia:

Latinia:	Foreign exchange saved:		$ 90
	Foreign exchange earned:		
	Banania	50+20%	60
	Andinia	100+20%	120
	Total		270
	Cost		190
	Net Benefit		80
Banania:	Foreign exchange lost	20% of 50	10
Andinia:	Foreign exchange lost	20% of 100	20
			30
	Group Benefits		50