

THE NEED AND CRITERIA FOR THE SECTORAL PROGRAMING OF AUSTRALIAN AID TO PAPUA NEW GUINEA

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A. *Scope of the Analysis of Sector Programing of Aid to Papua New Guinea*

AUSTRALIAN aid to Papua New Guinea (PNG) constituted nearly 18 per cent of GNP (in 1974) and in per capita terms in 1974 it was \$65.4. Furthermore, over the period 1961-74 Australian economic aid to PNG has increased at an average annual rate of around 12.5 per cent such that the per capita aid increased more than threefold. The quantum of aid and the rate of aid giving underlines the significant role the Australian economy has played and is destined to play in the development of PNG. The effectiveness of foreign aid to PNG can be evaluated at micro level or macro level, i.e., at project level or at a sectoral level respectively. In this paper we propose a sectoral framework or model that will evaluate aid at much more aggregative level than the project level. Such an evaluation provides us with broad policy guidelines for allocating aid amongst competing sectors on the basis of objective economic criteria. Working at a sectoral level will inevitably create some aggregation bias in our analysis. Nevertheless for planners and policymakers in donor and recipient countries a sectoral evaluation for programing foreign aid amongst competing ministries has real political and economic significance. (Refer to Table I for Australian aid details.)

B. *The Balance of Payments and Savings-Investment Gap Prospects Confronting Papua New Guinea*

Papua New Guinea shares with most developing countries the problem of scarcity of capital funds for investment in development activity. The need for infrastructure investments entailed heavy public and private expenditure in these spheres in the 1960s [8]. The total net capital inflow (including current transfers such as Australian grants) rose nearly 300 per cent and in the late sixties accounted for 90 per cent of gross domestic capital formation in the monetary sector [14]. The magnitude of Australian aid in PNG capital formation and the urgency of various development commitments, demands its efficient and effective disbursement at a sectoral level. Since sectors are aggregations of

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TABLE I
 AUSTRALIA'S ECONOMIC AID TO PAPUA NEW GUINEA TOTAL,
 PER CAPITA, AND AID AS PERCENTAGE OF GNP

Year Ended June 30	Grants from Australia (\$ Million)	Other Aid from Australia (a) (\$ Million)	Total Australian Government Economic Aid (\$ Million)	Per Capita Aid (\$)	GNP (\$ Million)	% Aid of GNP
1961	29.6	8.6	38.2	19.4	210.5	18.1
1962	34.6	9.8	44.4	21.9	226.6	19.5
1963	40.0	9.8	49.8	24.2	239.7	20.7
1964	50.5	10.7	61.2	29.1	253.1	24.1
1965	56.0	12.2	68.2	31.7	292.1	23.3
1966	62.0	13.4	75.4	34.5	322.5	23.3
1967	69.8	14.5	84.3	37.5	375.7	22.4
1968	77.6	14.8	92.4	40.0	413.0	22.4
1969	87.0	13.9	100.9	42.8	453.3	22.3
1970	97.0	19.3	116.3	46.7	531.0	21.9
1971	70.0	55.0	125.0	50.2	621.7	20.1
1972	69.9	66.6	136.5	52.8	645.5	21.1
1973	82.9	61.4	144.3	54.7	786.2	18.3
1974	133.1	44.0	177.1	65.4	1,003.8	17.6

Source: The Economist Intelligence Unit, *Quarterly Economic Reviews—Australia, Papua New Guinea*, Annual Supplement (London, 1975).

Note: (a) comprises: (1) aid expenditures of an economic nature by Australian government departments and instrumentalities; (2) assistance by official agencies; (3) salaries and allowances of the Australian Staffing Assistance Group; (4) Australian government loans.

projects on the basis of technological similarity of input or homogeneity of output or a combination of the two, the evaluation of sectors would, by the same token, imply evaluation of projects that comprise the sectors in a broad sense.

In the analysis of the balance of payments ("B of P") on current account (Table II), it can be seen that the deficit on current account until 1971/72 was considerable. However, with the commissioning of the Bougainville copper mine, PNG recorded its first substantial "B of P" surplus of \$279.2 million in 1973-74 (see Table IIA). It is also evident from the predictions in Table IIB that the "B of P" on current account will remain positive until the end of the decade. These predictions are based on the belief of increased volume and price of copper exports and an increasing volume of agricultural exports from plantation crops such as palm oil, coffee, copra, cocoa, and tea.

It should be noted that the balance of payments and therefore foreign exchange deficits up to 1971-72 were covered by the large inflows of private foreign investment [14]. Much of this aid was channelled to the Bougainville copper project. Added to this were the capital transfer and loans to the PNG government from Australia. It is pointed out in *Strategies for Nationhood—Policies and Issues* [9, pp. 27-28] that pre-1971 deficits on current account were the results of the

TABLE II
BALANCE OF PAYMENTS—CURRENT ACCOUNT

A. (\$ million current prices)

Year	Amount
1965-66	-87.6
1966-67	-101.7
1967-68	-107.1
1968-69	-104.0
1969-70	82.0
1970-71	-163.7
1971-72	-141.4
1972-73	76.5
1973-74	279.2

Sources: [9, Table 35]; and Papua New Guinea, *The Development Programme Reviewed* (Port Moresby: Government Printer, 1971), Table 2.5.

B. Projections (\$ million 1973-74 constant prices)

Year	Amount
1973-74 (actual)	106.7
1974-75	72.8
1975-76	54.5
1976-77	42.0
1977-78	60.1
1978-79	-4.7

Source: [9, Table 44].

Note: The balance on current account excludes (in this table) transfers to and from government sector.

capital inflow in so far as this inflow led to high levels of domestic capital formation that "directly and indirectly caused heavy outlays on imports." It seems likely, therefore, that with a decline capital inflow and the simultaneous increase in the economy's export earning capacity, the return to negative balance of payments figures on current account, in the short-term anyhow, seems unlikely.

Projections of the "B of P" figures up to 1979 provide some insight into how short term the surplus in balance of payments is going to be and in 1978-79 the current account of the balance of payments would be in the red. The causes for the reemergence of the deficit in the balance of payments according to the cited source [9, pp. 27-28] could be enumerated as follows:

(1) Slow increase in capital formation by the private sector from 1973-74 to 1976-77 and a significant increase during the period 1977-78 and 1978-79.

(2) Major infrastructural expenditures of the same magnitude as was undertaken for launching the Bougainville project are not envisaged. This means

that the country would be now better prepared than in 1969 to meet the demands for infrastructural services that will be required for undertaking large-scale investments in new projects in various sectors.

(3) The total value of exports of goods and services, including receipts from tourist expenditure in PNG, transport earnings, and other invisible receipts is expected to rise from \$531 million in 1973–74 to about \$630 million in 1978–79 on the basis of a conservative estimate.

(4) Imports of capital equipment are expected to increase significantly during 1977–78 and 1978–79 for the construction of further major projects in various sectors of the economy.

(5) The overall balance of payments outlook would be most favorable provided the 1973–74 terms of trade position continues.

In resume the balance of payments figures presented here warrants us to conclude that in the next two to three years PNG will continue to experience favorable “B of P” conditions and this stems from the fact that the copper mine ranks second only to foreign aid as a source of foreign exchange and government revenue.

Looking to savings and investment figures for Papua New Guinea, one can make the following observations on the basis of data in Tables III, IV, and V:

(1) A very high but generally declining proportion of gross capital formation is financed directly or indirectly through transfers from the rest of the world (aid from Australia, in particular).¹

(2) Private domestic savings has been increasing rapidly, but its impact on the economy has been diminished by expatriate savings payments (Table V).

(3) Public saving in the sense of excess of domestic revenue over current expenditure has been consistently negative (Tables III and IV).

From the above observations it would seem that Papua New Guinea’s development in the short run is determined to a large extent by the savings-investment gap as opposed to the balance of payments or foreign exchange (trade) gap. As Chenery and Strout point out in their two gap theory [2, Part 1], for a country to transform its economy to sustained growth, “success requires a simultaneous increase in skills, domestic saving and export earnings as well as an allocation of these increased resources in such a way as to satisfy the changing demands resulting from rising levels of income.” This paper is not directly concerned with the allocation of aid in the form of cash grants.² In the determination of allocation priorities, however, it becomes very important to identify the dominant gap, the savings gap or the foreign exchange (trade) gap. It is at this juncture that a choice has to be made out of the two versions of the two gap model. In our paper we have benefitted in this choice from the models postulated by Pronk and Schreuel [11]. Based on the foregoing analysis of the balance of payments

¹ This comment was first made in [8] and has been reiterated on page 104 of the reference [9] where it says “although one of the eight aims is to increase local revenue raising capacity so as to reduce dependence on aid, substantial reduction of this dependence will be a long term process. Therefore, one objective of policy for the coming years is to obtain sufficient aid to complement local revenue in providing sufficient funds for

TABLE III
PNG GOVERNMENT REVENUE BY SOURCE, SELECTED YEARS,
AND NATIONAL SAVINGS TOTAL

(Current prices)

Year	Internal Revenue*		Amount of Australian Grant†		Total Borrowing		Total Receipts
	\$ Million	%	\$ Million	%	\$ Million	%	
1960/61	14.9	37.9	29.6	65.3	0.9	1.9	45.4
1965/66	34.0	33.3	62.0	60.7	6.2	6.0	102.2
1970/71	83.4	43.8	76.3	40.1	30.7	16.1	190.4
1971/72	95.3	45.3	81.6	38.8	33.7	16.0	210.5
1972/73	93.1	43.1	85.9	39.8	36.9	17.1	215.8
1973/74	136.1	43.6	133.1	42.5	43.6	13.9	313.0
1974/75 (estimate)	169.5	54.5	89.2	28.7	52.6	16.9	311.3

Sources: [9, p. 136]; and PNG *National Accounts Statistics, 1960/61-1973/74*.

* Includes such items as customs, licenses, stamp duties postal, land revenue, mining receipts, forests, agriculture, public utilities, direct taxation, miscellaneous, recoverable services.

† There is a slight discrepancy between the figures for Australian grants in this table and the amounts shown in Table I. The difference is attributable to the definition of "grants" and the figures stated above may include some amounts that were included in the column "other aid from Australia" in Table I.

TABLE IV
GOVERNMENT EXPENDITURE ON GOODS AND SERVICES
AND DOMESTIC CAPITAL FORMATION

(\$ million current prices)

Year	Amount
1960/61	77.10
1961/62	80.94
1962/63	90.68
1963/64	105.84
1965/66	141.99
1970/71	246.00
1971/72	296.10
1972/73	308.60
1973/74	358.60
1974/75 (estimate)	381.30

Sources: [9, p. 136]; and PNG *National Accounts Statistics, 1960/61-1973/74*.

all expenditure planned by the government."

² Aid in the form of technical assistance would, in the short run, remedy the "lack of skills" bottleneck in the completion of a project.

TABLE V
PRIVATE DOMESTIC SAVINGS AND EXPATRIATE SAVINGS REMITTANCES

Year	(\$ million)		
	Total Domestic Savings, Current Prices	Total Domestic Savings, Constant Prices*	Expatriate Savings Remittances, Current Prices
1965/66	55.0	67.8	16.7
1966/67	62.6	69.3	18.6
1967/68	65.9	68.7	24.3
1968/69	67.0	67.0	29.3
1969/70	84.1	79.8	33.6
1970/71	99.7	89.3	50.3
1971/72	69.7	61.7	50.0
1972/73 (p)	165.7	130.8	
1973/74 (p)	309.8	214.7	

Source: PNG National Accounts Statistics, 1960/61–1973/74.

* The base year is 1968/69.

and savings-investment gap situation in PNG we have modified the Pronk-Schreuel model for the PNG analysis.

The basic problem that has confronted Papua New Guinea has been the distribution of aid within the economy so that the "Eight Aims" outlined by the Prime Minister Michael Somare (see Appendix A) can be achieved within the shortest possible time. With the employment of the modified savings-investment gap model of the Chenery-Strout type [2], aid allocation criteria can be derived so that the "Eight Aims" can be achieved effectively and efficiently.

C. Sectoral Direct Aid (Project Aid) versus Sectoral Bunch (Program) Aid

Sectoral direct aid is that aid allocated for the expansion of one sector. This expansion is achieved through the completion of projects. A sectoral direct aid analysis would consider *only* the cost and benefits for the expansion of that sector. Bunch aid or program aid refers to direct and indirect expansionary effects of undertaking projects in a sector. In the Papua New Guinea example, if Australia gave the PNG government \$20 million to build a hydroelectric power station at a particular place, this would be classified as project aid to the electricity sector and it would refer to the direct cost-benefits or repercussions only. Bunch aid [12], using the same example, would make allowances for expenditures in complementary sectors such as road construction, acquisition of transport, and the installation of other essential services to the construction site. Program aid is that aid granted to a country for the realization of an economic development package—in the case of PNG, their five-year plans.

The basic problem with sectoral direct or project aid is its failure to recognize the indirect returns and costs that arise because of the project. This, sometimes, is of little significance to the donor of the project aid. The problem becomes one of some magnitude, however, for the recipient. The direct returns to a project are obvious—an iron and steel plant the less developed country (LDC) did not have before, the increase in copper production, or a new power generation

plant. The costs of building a power plant or a steel plant are obvious. An economy, however, is a complex interdependence of sectors and as a result, the modification of one sector will have an influence in most other sectors of the economy—this is the indirect effect of a project. The roads that have to be built, the increased services required, the new machinery that has to be built are all costs that have to be incurred by the economy if the project is to be realized.

Herein, lies an objective criterion for efficient and effective aid allocation of Australian aid to Papua New Guinea and also for rational disbursement of aid funds amongst competing sectors within the recipient country. For decision-makers in PNG to make economic decisions (i.e., properly assess the opportunity costs of a project) about how aid is to be spent, the bunch effects or total effects of an expansion in a sector should be known, i.e., all the costs and benefits, direct and indirect, that occur when an investment is made in a particular sector. To do this the direct and indirect effects of the expansion have to be isolated.

The semi-input model due to Tinbergen [12] could be adopted to appraise the indirect effects of an expansion in one sector and simultaneously consider the bunch of investments associated with the aid devoted to an expansion in one sector. A resume of the assumptions and the methodology of this technique follows.

D. *The Rationale of Semi-Input-Output Method for Sectoral Aid Allocation*

The semi-input-output model rests on the following basic assumptions:

(1) The country's development policy aims at the utilization of all existing capacities, all qualified manpower needed is actually available and no shortages or surpluses occur.

(2) A distinction can be made between domestic or national and international products of economic activity. The former cannot be imported or exported for technological, cultural, or legal reasons.

(3) Inter-industrial supplies are proportionate to the increase in production in the receiving sector.

(4) When income is increasing, consumption of different goods is linearly dependent on this income.

(5) The normal assumptions about the production relationships of the input-output analysis remain in force, i.e., the existence of constant returns to scale and generalized diminishing returns.³

The semi-input-output model requires the identification of international and national sectors of an economy. Given a desire to increase the output of an international sector by some predetermined amount, say, X , this method calculates the total investment in the economy required to achieve this goal. The assumption that is made to simplify calculations is that the expansion of one of the international sectors does not also necessitate the expansion of another international sector. In support of this assumption, Tinbergen makes the following point:

³ For a more complete discussion refer [4].

This [dual expansion] is in principle neither necessary nor even always desirable, especially if one of the other sectors, judged according to its bunch, happens to be unattractive. [12]

Tinbergen goes on to make the important point that the subsequent expansion in other international sectors can be met by means of overseas trading. This means that there need not be an expansion in national sectors to meet this "secondary" effect of expanding one international sector.

...an expansion of the weaving industry does not necessarily imply a corresponding expansion in the spinning industry—the yarn required can be imported. Whether a corresponding expansion in spinning is also attractive is something that has to be considered separately. [12]

Consequently, one can make a decision about the desirability of the expansion in an international sector individually and independently with respect to other international sectors. The technique of semi-input-output analysis, however, details the type and amount of investment required in the national sectors (this being referred to as "indirect effects") to bring about that desired (X) increase in output of the international sector.

E. *A Model for Programing Aid at Sectoral Level*

The model proposed herein for programing sectoral aid to PNG is based on a modification of semi-input-output model as suggested by Pronk and Schreuel [11]. The modified model requires n_1 international sectors and n_2 national sectors where $n = n_1 + n_2$ and therefore n is the total number of sectors identified in an economy. Prices are taken to be equal to unity and there is assumed to be NO time lag between investment and the resulting capacity expansion.⁴ All Latin symbols refer to the differences between the values which the various magnitudes will take as a result of the capacity expansion of an international sector implied by a project, and the values they would take without the project. Thus these symbols refer to a change within one time period not changes over time.

Variables:

x_i = production of sector i .

a_i = intermediate inputs of the i th sector.

c_i = consumption (private and public) of sector i .

I_i = new investments (fixed investment as well as stock formation) in i th sector.

(x_i, a_i, c_i, I_i expressed in value terms.)

E_i = exports less imports of sector i .

Y_i = value added by sector i .

S = total savings.

Parameters:

$\alpha_{i,j}$ = current input coefficients from sector i into sector j .

⁴ This is quite an unrealistic assumption if we are also to assume no excess or unutilized capacity in the economy. To make allowance for it, the methodology of discounting over time could be in the analysis. For a more detailed discussion on the intertemporal aspects of investment refer to J. Tinbergen [13].

γ_i = the propensity to consume product i .
 σ = marginal domestic savings ratio.
 β_{ij} = partial incremental capital-output ratios from sector i into sector j .
 (Note: Because of assumption [4] in section D, γ_i = MPC product i = APC product i .)

For the tradable (or international) sectors we have:

$$x_i = a_i + c_i + I_i + E_i. \quad (i=1, 2, \dots, n_1) \quad (1)$$

For the non-tradable (or national) sectors we have:

$$x_i = a_i + c_i + I_i. \quad \{i=(n_1+1), \dots, n\} \quad (2)$$

$$a_i = \sum_{j=1}^n \alpha_{ij} x_j. \quad (i=1, 2, \dots, n) \quad (3)$$

$$I_i = \sum_{j=1}^n \beta_{ij} s_j. \quad (i=1, 2, \dots, n) \quad (4)$$

$$Y_j = \left[1 - \sum_{i=1}^n \alpha_{ij} \right] x_j. \quad (j=1, 2, \dots, n) \quad (5)$$

$$c_i = \gamma_i Y. \quad (i=1, 2, \dots, n) \quad (6)$$

$$S = \sigma y. \quad (7)$$

$$Y = \sum_{i=1}^n Y_i. \quad (8)$$

$$c = \sum_{i=1}^n c_i. \quad (9)$$

$$I = \sum_{i=1}^n I_i. \quad (10)$$

$$E = \sum_{i=1}^{n_1} E_i. \quad (E_i=0 \text{ for } i=n_1+1, \dots, n) \quad (11)$$

The semi-input-output method makes the x_i of the international sector to be given (say sector 1) equal to x and the x_i 's of the remaining tradable sectors as equal to zero. Thus, we have

$$x_1 = x. \quad (12)$$

$$x_i = 0. \quad (i=2, 3, \dots, n_1) \quad (13)$$

From the national accounts identity it follows that:

$$\sum_{i=1}^n \gamma_i + \sigma = 1 \quad (14)$$

It can be seen that there are $(5n + n_1 + 5)$ independent linear equations. The number of variables equal $n(x_i$'s) + $n(a_i$'s) + $n(c_i$'s) + $n(I_i$'s) + $n(E_i$'s) + $n(Y_i$'s) + $5(S, y, c, i, e)$ or $(5n + n_1 + 5)$. Thus, the system gives a unique solution.

It should be noted that the model variables are defined as absolute amounts, i.e., volume of investment, volume of production, etc. The overall analysis is not principally concerned with absolute volumes but rather changes in volumes. Hence mention will be made of increasing the output of tradable sector i by X amount. The aim of this analysis is to identify the changes required in the non-tradable sectors to achieve the stated level, X . The emphasis placed on "changes

in amounts" does not invalidate the model just outlined nor does it invalidate the definitions of variables. For example, if the output of sector 1 is increased by (say) 1 unit then

$$\Delta x_1 = 1,$$

and

$$\Delta x_1 = \Delta a_1 + \Delta c_1 + \Delta I_1 + \Delta E_1 \text{ (from equation [1]).}^5$$

In this model the domestic savings ratio (σ) is fixed for the economy but the balance of payments follows as a residual. This model, therefore, assumes that a country's development is limited by the "savings gap" referred to earlier. Hence, the foreign exchange needs can be taken for granted. As a result, the size of the balance of payments effects is of importance as a guide to short-term domestic policy and to the aid policy of donors. The criteria for appraisal would then be the ratio between total investment increases and total value added (GDP) increases. This model also allows for other forms of appraisal criteria that are not included in the model, such as employment or income distribution.

It is noted by Pronk and Schreuel [11] that the I/y ratio will give the same ranking of the sectors as the ranking according to the balance of payments effect per unit of value added. If we assume that

$$S = I + E,$$

and that

$$S/Y = \sigma,$$

then

$$\sigma = \frac{I}{Y} + \frac{E}{Y}.$$

As long as σ is constant, then investments per unit of value added and balance of payments effect per unit of value added must move in opposite directions. If, however, one is interested in the absolute balance of payments effect and this is used for the criterion of appraisal, then another ranking would prevail.

F. Empirical Validation of the Proposed Model for Papua New Guinea

The data base upon which Table I was constructed was that developed by Parker [10] and modified by Karunaratne [5]. The Papua New Guinean economy is aggregated into ten sectors, these sectors being:

- | | | |
|---|--|--|
| <ol style="list-style-type: none"> 1. Agriculture 2. Fishing, forestry, mining 3. Manufacturing 4. Commerce 5. Business expenses | $\left. \vphantom{\begin{matrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{matrix}} \right\}$ | International
(tradable)
sectors |
|---|--|--|

⁵ When a change in x_i is made there will be a change in all other variables in the model. Thus to define, say, x_i to be the volume of production of sector i is synonymous to defining x_i to be a change in the volume of production of sector i . For brevity of symbolism, the notation outlined in the definitions of the variable will be used throughout this analysis in preference to the use of the "Δ" symbol.

- | | | |
|--|---|---------------------------------------|
| 8. Electricity
6. Building and construction
7. Transport and communications
9. Services (including government)
10. Non-market production | } | National
(non-tradable)
sectors |
|--|---|---------------------------------------|

Table VI indicates the inter-industry transactions for the year 1970, and it forms the basis for many of the tables that are to follow.

Applying the model outlined in Section E we have:

$$n_1=5, \quad n_2=5, \quad n=10.$$

$$\begin{aligned}
 (1) \quad & \left[\begin{array}{l} x_1 = \alpha_{11}x_1 + \alpha_{12}x_2 + \dots + \alpha_{1\ 10}x_{10} + c_1 + I_1 + E_1. \\ x_2 = \alpha_{21}x_1 + \alpha_{22}x_2 + \dots + \alpha_{2\ 10}x_{10} + c_2 + I_2 + E_2. \\ \vdots \\ x_5 = \alpha_{51}x_1 + \alpha_{52}x_2 + \dots + \alpha_{5\ 10}x_{10} + c_5 + I_5 + E_5. \end{array} \right. \\
 (2) \quad & \\
 (3) \quad & \left[\begin{array}{l} x_6 = \alpha_{61}x_1 + \alpha_{62}x_2 + \dots + \alpha_{6\ 10}x_{10} + c_6 + I_6. \\ \vdots \\ x_{10} = \alpha_{10\ 1}x_1 + \alpha_{10\ 2}x_2 + \dots + \alpha_{10\ 10}x_{10} + c_{10} + I_{10}. \end{array} \right.
 \end{aligned}$$

$$(4) \quad \left[\begin{array}{l} I_1 = \beta_{11}x_1 + \beta_{12}x_2 + \dots + \beta_{1\ 10}x_{10}. \\ \vdots \\ I_{10} = \beta_{10\ 1}x_1 + \beta_{10\ 2}x_2 + \dots + \beta_{10\ 10}x_{10}. \end{array} \right.$$

$$(5) \quad Y_i.$$

$$(6) \quad \left[\begin{array}{l} c_1 = \gamma_{1y}. \\ \vdots \\ c_{10} = \gamma_{10y}. \end{array} \right.$$

$$(7) \quad S = \sigma y.$$

$$(8) \quad y = \sum_{i=1}^{10} y_i.$$

$$(9) \quad c = \sum_{i=1}^{10} c_i.$$

$$(10) \quad I = \sum_{i=1}^{10} I_i.$$

$$(11) \quad E = \sum_{i=1}^5 E_i.$$

Now, let the output in sector 1 (agriculture) increase by 1 unit, i.e., $\bar{x}_1=1$, and all other tradable sector outputs remain unchanged, i.e., $x_2, x_3, \dots, x_5=0$. The system of equations will reduce to the equations as follows [13]:

TABLE VI
PAPUA NEW GUINEA INTER-INDUSTRY TRANSACTIONS, 1970

	(\$ million in purchasers' value)										Investment Public & Private	Export Import	Total Output	
	1	2	3	4	5	6	7	8	9	10				Consump- tion
1	1.53	0.00	6.86	0.00	0.02	0.00	0.20	0.00	0.45	0.00	8.06	7.12	53.40	77.44
2	0.01	0.00	3.24	0.00	0.01	0.04	0.00	0.00	0.07	0.00	1.67	-0.07	5.78	10.75
3	5.67	0.22	3.73	1.14	1.06	26.49	7.44	0.01	4.72	0.00	30.43	2.20	13.14	96.25
4	3.52	0.96	10.85	0.51	0.96	6.14	2.57	0.34	0.67	0.00	20.53	8.75	2.46	58.26
5	1.16	0.32	3.06	9.36	0.00	5.49	1.71	0.17	4.51	0.00	0.00	0.00	2.43	28.21
6	0.26	0.00	0.14	0.45	0.05	0.47	0.13	0.01	12.79	0.00	0.00	100.15	—	114.45
7	2.97	0.20	2.67	1.04	7.97	2.83	2.22	0.39	14.31	0.00	10.77	0.64	—	49.78
8	0.06	0.06	0.74	0.43	0.54	0.12	0.09	0.00	2.28	0.00	1.99	0.00	—	6.62
9	0.63	0.72	0.13	5.08	5.80	0.73	0.35	0.02	4.80	0.00	146.11	6.90	—	174.30
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	185.50	38.30	—	223.90
Value added	56.13	5.87	42.93	38.47	0.55	32.13	26.91	4.64	108.43	223.90	—	—	—	539.96
Total											494.35	238.87	90.73	1,164.10

Source: [5, Table I].

$$\bar{x} = \alpha_{11}\bar{x}_1 + \alpha_{16}x_6 + \alpha_{17}x_7 + \dots + \alpha_{1\ 10}x_{10} + c_1 + I_1 + E_1.$$

⋮

$$x_6 = \alpha_{61}\bar{x}_1 + \alpha_{66}x_6 + \alpha_{67}x_7 + \dots + \alpha_{6\ 10}x_{10} + c_6 + I_6.$$

⋮

$$x_{10} = \alpha_{10\ 1}\bar{x}_1 + \alpha_{10\ 6}x_6 + \alpha_{10\ 7}x_7 + \dots + \alpha_{10\ 10}x_{10} + c_{10} + I_{10}.$$

This is a set of six simultaneous equations in five unknown since the c_i , I_i , and E_i values cannot be found or assumed not to exist.⁶ Ignoring the first equation, it becomes possible to solve the remaining five equations to give a unique solution for x_6 , x_7 , x_8 , x_9 , and x_{10} .⁷ That is, given a desired unit expansion in output of sector 1 (agriculture), the solution to the simultaneous equations indicate by how much the outputs of the non-tradable sectors have to increase if the unit expansion in agriculture is to be achieved.

For each of the international sectors identified in the Papua New Guinea economy, the total and direct effects of a capacity expansion of the tradable sector have been calculated. Such calculations include value added, investment (both international and national), and the balance of payments. These subdivisions make it possible not only to point out the importance of the indirect effects in general, but also the quantitative consequences of tying aid solely to one aspect of an expansion or a bunch. It will also assist in the conclusions one can make about Australian aid policy toward Papua New Guinea.

The interpretation of results in Table VII would follow the same rationale outlined here. Looking at a unit increase in output of the agricultural sector (column 1, Table VII) it can be seen that in order for this to be achieved the building and construction sector needs to expand its output by 0.0042 units, the transport and communications sector by 0.0411 units, the electricity sector by 0.001 units, and the services sector by 0.0087 units. The unit increase in the output of the agricultural sector requires a total investment of 1.1672 units of which 0.2622 units come from international sources. If one considers only international direct investment in the attainment of the one unit expansion in the agricultural sector one will find 0.1378 units of international (direct) investment is required. It was already found, however, that a total of 0.2622 units of international resources were required if the one unit expansion was to be achieved. Hence to look at international direct investment requirements, only, would result in ignoring 47 per cent of total international investment required for the unit expansion to succeed.

The results are summarized in Tables VII and VIII. Table VIII was constructed so as to get a clearer picture of the consequences of tying aid to part only of the total investment needs of a project.

⁶ A simplifying assumption is made at this point. It is that c_i , I_i , and E_i are set to zero, or in other words, the changes in sectoral consumption, investment, and net exports that result from changes in sectoral outputs is assumed to be zero.

⁷ A more advanced mathematical formulation is given in Appendix B for the solution of this set of equations.

TABLE VII
THE EXPANSION REQUIRED IN NATIONAL SECTORS TO SUPPORT A UNIT
EXPANSION IN SELECTED INTERNATIONAL SECTORS

	Bunch Connected with Sector				
	1	2	3	4	5
Capacity expansion of the international sector to be appraised:					
1. Agriculture	1				
2. Mining, forestry, fishing		1			
3. Manufacturing			1		
4. Commerce				1	
5. Business expenses					1
Required expansion of gross output levels of the national sectors:					
6. Building & construction	0.0042	0.0002	0.0017	0.0144	0.0185
7. Transport & communications	0.0411	0.0259	0.0297	0.0274	0.2905
8. Electricity	0.0010	0.0066	0.0078	0.0086	0.1524
9. Services (including government)	0.0087	0.0691	0.0016	0.0899	0.2132
10. Non-market production	0	0	0	0	0
11. Total value added	0.7543	0.609	0.4690	0.7411	0.4212
12. Direct value added	0.7248	0.5460	0.4460	0.6603	0.0195
13. Total investments	1.1672	2.9029	2.1506	1.0092	3.3004
Of which international	0.2622	1.4348	1.0455	0.2163	1.5799
14. All direct investments	1	2.5	2	0.5	0.5
Of which international	0.1378	1.2576	0.942	0	0.1
15. Total "B of P" effect (minus)	0.9788	2.7508	2.0334	0.8241	1.4747
16. Direct "B of P" effect	0.6971	-0.3993	-0.3611	0.7797	0.8070

Note: Subscript p refers to the sector in which the increase in output is to be made (p stands for project).

Rows	Formula or Symbol
1-5:	$x_p = X = 1.$
6-10:	$x_i. \quad (i=6, 7, 8, 9, 10)$
11:	$y.$
12:	$y_p.$
13:	$\sum_{j=1}^{10} \sum_{i=1}^{10} \beta_{ij} x_j.$ $\sum_{j=1}^{10} \sum_{i=1}^5 \beta_{ij} x_j. \quad (\text{international})$
14:	$\sum_{i=1}^{10} \beta_{ip} x_p. \quad (\text{total direct investment})$ $\sum_{i=1}^5 \beta_{ip} x_p. \quad (\text{international direct investment})$
15:	$I - \sigma y = -e.$
16:	$x_p - \sum_{j=6}^{10} (\alpha_{pj} + \beta_{pj}) x_j - \left\{ \sum_{i=1}^5 \alpha_{ip} + \beta_{ip} \right\} x_p - C_p y.$

TABLE VIII
NEGLECTED INDIRECT EFFECTS AS A PERCENTAGE OF TOTAL EFFECTS

	Bunch Connected with Sector				
	1	2	3	4	5
I. Per cent of total investment neglected when considering only all direct investments	14	14	7	51	85
II. Per cent of the total need of international investment goods neglected when considering only international direct investments*	47	13	10	100	94
III. Indirect balance of payments effect as a per cent of total "B of P" effect	170	85	82	195	154

* Indicates the percentage of total international investment ignored when one looks only at international investment needs of one sectoral expansion.

G. *Implications of Semi-Input-Output Sector Appraisal of Papua New Guinea*

Before looking into Australia's aid policy, let us comment on the results displayed in Tables VII and VIII for the PNG economy. Considering investment in a particular tradable sector, the proportion of total investment ignored when looking at investment in one project only ranges from a low 7 per cent for the manufacturing sector to a high 85 per cent for the business expenses sector. This latter figure is to be ignored since the classification is a dummy one used by Parker to account for numerous but small business transactions [10, p. 20].

Referring to Table VI, we see that a considerable amount of the output of sector 9 (services) goes as input for sector 4 (commerce). Hence, to look only at the expansion of the commerce sector would lead to ignoring some 51 per cent (see Table VIII) of total investment that is required to realize the unit expansion of the commerce sector.

Part II of Table VIII gives an impression of the foreign exchange burden left to PNG if aid is given to finance the import content of a project's direct investment. These percentages are given so as to indicate the ramifications of one of the assumptions of the Tinbergen semi-input-output method, that is, all investment requirements for a project will come from non-tradable sectors. If the project requires outputs from tradable sectors, these will be imported into PNG. This assumption was made in order to make the ranking of sectors possible. If movement of goods between tradable sectors as well as movements between tradable and non-tradable sectors was allowed, then the sector appraisal would be extremely difficult. For PNG (refer Table VIII, Part II), this assumption seems to be quite costly. For example, if agricultural output was to be increased by one unit, then nearly half of the investment required would be imported, because of the assumption of this model. Mining, forestry, and fishing as well

as manufacturing are not so heavily dependent on resources from other tradable sectors but commerce is very dependent.

Part III of Table VIII shows the considerable mistake which is made when attention is directed solely to the direct balance of payments effects of a project. In the case of sectors 1 and 4 the direct "B of P" effect is positive as a result of an increase in output of that sector. The total "B of P" effect, however, is negative which is consistent with the results of Part II of the Table VIII, thus giving the proportion of indirect "B of P" effects greater than 1. In the case of sectors 2 and 3, the indirect effects are still considerable. It is worth noting, however, that the export earning capacity of sector 2 has risen sharply since 1972. As was indicated earlier, the copper mine now contributes significantly to PNG's export earnings. Consequently, the figure of 85 per cent (indirect "B of P" effect) in Table VIII would now be too high. In 1970, the base year for Table VI (and therefore the base year for this analysis), the Bougainville project was still in the construction and development phase when large amounts of foreign investments were required. This requirement would be included in the 85 per cent figure. Today, however, the main flow of foreign exchange is in the form of revenue from copper sales and as a result the indirect balance of payments effects would be reduced.

The figures in Table VII may also be used to rank the international sectors on the basis of a criterion which measures the investment cost per unit of value added created. According to whether one takes into account the total investments, or the direct investments only, different ways of ranking can be distinguished. These are found in Table IX.

Some interesting conclusions may be drawn from this table:

(1) Ranking according to investment criteria does not depend on the bunch approach or the sectoral approach.

(2) Using the bunch "B of P" effect as the criterion, the ranking changes considerably with respect to that ranking obtained using either investment criteria.

TABLE IX
RANKING OF SECTORAL INVESTMENT

	Bunch Connected with Sector				
	1	2	3	4	5
Criterion of investments/unit of VA calculated as a quotient of:					
(13) and (11)	1.55	4.77	4.58	1.36	7.84
(14) and (12)	1.38	4.58	4.48	0.76	2.56
Rank according to investment criteria:					
(13) : (11)—bunch approach	2	4	3	1	5
(14) : (12)—project approach	2	4	3	1	5
Rank according to foreign exchange criteria:					
(15)—bunch approach	2	5	4	1	3
(16)—project approach	3	5	4	2	1

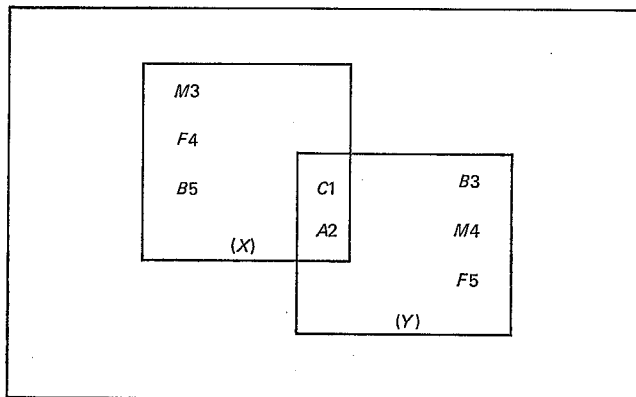
(3) The ranking using the "B of P" criteria is heavily dependent on the type of analysis used. That is, using the bunch approach gives the different ranking to that got by using the sectoral approach.

(4) Considering only the direct balance of payments effects gives an important change in ranking in comparison with all other criteria.

Observation (1) indicates that for the PNG case the consideration of indirect effects may be superfluous in the analysis. A similar finding was also made in a study on India by Pronk and Schreuel [11]. It should be noted, however, that this analysis has not explicitly referred to the real world complication in an economy such as import quotas, export incentives, taxation relief schemes, indivisibilities of a project, and demand fluctuations in world markets. Observations (2), (3), and (4), however, indicate that for the PNG economy the appraisal criteria for sectoral investments is very important. The use of investment as opposed to "B of P" criteria influences the results markedly. Furthermore, the use of project as opposed to bunch criteria with respect to "B of P" considerations is of importance. These latter observations should not come as a surprise. As was indicated in the earlier sections of this paper, PNG has had a persistent "B of P" problem for many years and, given the objectives of the Second Five-Year Plan,⁸ the "B of P" problem will be of significance for some time to come. This is a result of the underdevelopment of the capital producing tradable sector in the economy. Hence, it is not surprising to see sectors 2 and 3 receiving a low ranking on the balance of payments criteria.

Referring to Figures 1 and 2, it can be seen that, using the bunch approach, commerce and agriculture are ranked 1 and 2 for both appraisal criteria for the PNG economy. Using the project approach, no two sectors have the same ranking

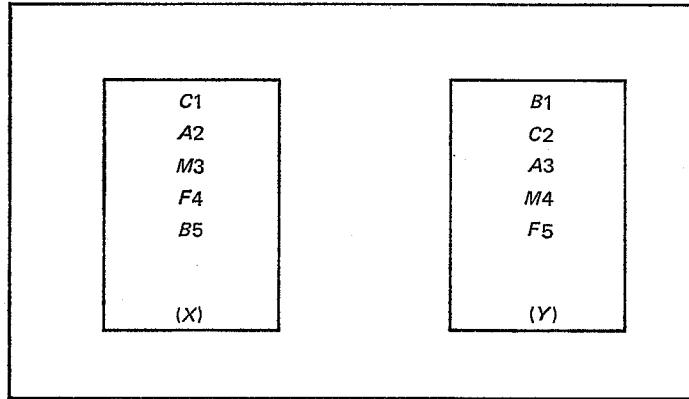
Fig. 1. Bunch Approach



Note: Set (X)—rankings using investment criteria; set (Y)—rankings using foreign exchange criteria.

⁸ The First Five-Year Plan was aimed at "capitalizing" the whole PNG economy. The Second Five-Year Plan shifted the emphasis onto capitalizing the subsistence sector. Consequently, the expansion in the manufacturing sector has not been great and therefore the capital producing element of the economy is not greatly developed.

Fig. 2. Project Approach



Note: Set (X)—rankings using investment criteria; set (Y)—rankings using foreign exchange criteria; A—agriculture sector; B—business expenses sector; C—commerce sector; M—manufacturing sector; and F—fishing, forestry, mining.

for both appraisal criteria, but agriculture is ranked 2 in set (X) and 3 in set (Y) whilst commerce is ranked 1 in set (X) and 2 in set (Y). On the basis of these Venn diagrams, the commercial and agricultural sectors in the PNG economy are two sectors which would produce the most favorable investment and balance of payments impact as a result of development of these sectors.

The foregoing discussion on sectoral rankings should not detract attention from the fact that the technique developed not only gives ordinal measures of attractiveness of sectors but also a cardinal measure. The cardinal measures are contained in Table VII.

Before going on to suggest how these results are useful, let us review the assumptions upon which the analysis is based. Mention has already been made of the problem of aggregation bias. Parker identifies twenty-one sectors in the PNG economy [10]. This study has amalgamated some of these to form a ten sector economy. A basic aim of this study is to develop aid allocation criteria and we believed this aim could be adequately achieved by use of the aggregated model. As well, the analytical framework is flexible in as much as the twenty-one sector model can be used instead of the ten sector model. A more serious problem relates to the instantaneous effects of investment in a sector [13]. This approach negates the requirement for a time discounting analysis to evaluate the costs and benefits of sectoral investments and the resultant expansion. It is a refinement that would make the analysis more "real" but it is felt that this shortcoming does not invalidate the model and its attempts to quantify the direct and indirect effects of sectoral investment. The "instantaneous effects" assumption is a strong one and may give extreme results. One extreme is that the results of this analysis identify and quantify the minimum levels of the indirect effects of investment. The other extreme is the results represent maximum values. Finally, the input-output table used to derive Table VI is Parker's 1970

table instead of his "inter-industry transactions, projected to 1978" table [10]. We believed that workable aid allocation criteria could be derived adequately on the 1970 table.

H. *Lessons for Australian Aid Programing to Papua New Guinea*

It is particularly difficult to be critical of Australia's aid policy to Papua New Guinea because of several factors:

- (1) assistance to PNG is untied [3, p. 126];
- (2) the establishment of the Australian Development Assistance Agency (ADAA) whose task is to regulate the formulation of aid policy and the welfare and distributive effects of Australian aid [1];
- (3) the hesitancy Australia has displayed when granting aid to PNG to direct how the aid is to be used; and
- (4) the fruitful and friendly interface that exists between PNG and Australia for discussion on how the aid is to be used.

Nevertheless, Australia should still be concerned about the most effective way its aid can be used by PNG. Simply giving money to the government may not be in the best interests of the Australian taxpayer as the donor of the money. On the other side of the aid deal, PNG should want to get "the most" out of its aid from Australia. Once one begins to talk about matters such as these however, problems and criticisms arise about value judgments and criteria for development. To avoid this controversy, the priorities for PNG's development will be taken to be given in the "Eight Aims" outlined by Mr. M. Somare (see Appendix A). This point will be raised again shortly.

Unfortunately, Australia's aid policy seems to be moving in the opposite direction to that suggested by the results outlined in Sections F and G of this paper. In other words, Australian policy is moving towards sectoral aid and aid for specific tasks.

A part of the development grant will also be devoted to a form of project aid... project aid to PNG will take the form of financial support for specific activities... it will involve financial transfers to the PNG Government. [1]

Secondly, if one considers the \$187 million of "total net aid" given to PNG in 1974/75, only \$40 million (or 21 per cent) was in the form of development grants—cash grants for development projects. The remainder was "tied" to grant-in-aid (budgetary support), the Australian Staffing Assistance Group and termination and retirement benefits payments [1].

The findings of Sections F and G indicate that sectoral aid is inferior to bunch aid because of the financial burden the former places on the recipient nation. Consequently, Australia's planned move to project aid is ill-advised, unless we appreciate that other parts of the PNG economy will require financial assistance also if the expansion is to be realized satisfactorily. Further, one could suggest that the percentage of actual untied aid should be increased thereby allowing for more ambitious development prospects for PNG without the government having to seek out other amounts of money—be it aid or loans.

For Papua New Guinea the semi-input-output approach gives a clear indication of the amounts of aid required and its distribution if it is to achieve a policy goal set up in a tradable sector. In fact, this type of investment analysis can assist PNG in achieving many of the "Eight Aims" set up in 1974.

The content of aim 1 (New Guineanization of the economy) would influence the sectoral rankings in Table IX so that a higher priority would be given to the bunch that would cause the largest reallocation of resources into the control of Papua New Guineans. Hence, social, as well as economic, criteria would be used to evaluate priorities. Having the results of Section F would also assist planners to decentralize economic activity, planning, and government spending (aim 3). Knowledge of the balance of payments effects for various projects would assist planners to achieve aim 5; a more self-reliant economy, less dependent for its needs on imported goods and services. Further, understanding how economic consequences of a project are distributed throughout the economy, the remainder of aim 5 and aim 8 (government control of specified sectors) can be achieved using the rational economic criteria used in the semi-input-output method.

I. *Conclusions*

This paper has been concerned with the identification of the direct and indirect effects of sectoral expansion in the PNG economy and the subsequent ranking of sectors according to investment and balance of payment criteria. A discussion on the types of aid, arguments for and against the several types, and the influences of political overtones in the donor and recipient countries has been omitted [6]. Once these considerations are brought into the discussion one is faced with another subject: a critical study of the practices of aid giving.

The aim of this paper was to stress the indirect effects associated with an expansion of one sector and how these effects could influence the aid appraisal criteria used by the Australian and Papua New Guinean governments in aid allocation. Comments have been made concerning Australia's aid policy and an indication was given as to how the semi-input-output results would be amalgamated with social (noneconomic) criteria and used by the PNG government in the achievement of the "Eight Aims" in the most efficient and economic manner.

The results of the numerical analysis indicate that bunch and plan (program) aid is to be preferred to project aid for the development of PNG's economy. On the basis of Table IX, investment in the commerce sector is the most attractive with respect to the investment and "B of P" criteria. Development of the agricultural sector is the second most attractive investment prospect (again with respect to both appraisal criteria). In other LDCs bunch aid may be a problem because of the donor-recipient interface that is required at a macro level, but because of the past and present situation in Australian-Papua New Guinean economic cooperation, the giving and use of bunch aid for the development of PNG should not prove to be an obstacle and therefore enhance the prospect for the rapid and balanced growth of the PNG economy.

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APPENDIX A

PAPUA NEW GUINEA'S EIGHT AIMS

1. A rapid increase in the proportion of the economy under the control of Papua New Guinean individuals and groups and in the proportion of personal and property income that goes to Papua New Guineans.
2. More equal distribution of economic benefits, including movement toward equalization of incomes among people and toward equalization of services among different areas of the country.
3. Decentralization of economic activity, planning, and government spending, with emphasis on agricultural development, village industry, better internal trade, and more spending channelled to local and area bodies.
4. An emphasis on small-scale artisan, service, and business activity, relying where possible on typically Papua New Guinean forms of business activity.

5. A more self-reliant economy, less dependent for its needs on imported goods and services and better able to meet the needs of its people through local production.
6. An increasing capacity for meeting government spending needs from locally raised revenue.
7. A rapid increase in the equal and active participation of women in all forms of economic and social activity.
8. Government control and involvement in those sectors of the economy where control is necessary to achieve the desired kind of development.

APPENDIX B

MATRIX FORMULATION OF THE SEMI-INPUT-OUTPUT METHOD

In matrix notation let

$$x = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_{10} \end{bmatrix}; \quad A = \begin{bmatrix} \alpha_{11} & \alpha_{12} & \cdots & \alpha_{1\ 10} \\ \vdots & & & \\ \vdots & & & \\ \vdots & & & \\ \alpha_{10\ 1} & \cdots & \cdots & \alpha_{10\ 10} \end{bmatrix};$$

$$F = \begin{bmatrix} c_1 \\ c_2 \\ \vdots \\ c_{10} \end{bmatrix} + \begin{bmatrix} I_1 \\ I_2 \\ \vdots \\ I_{10} \end{bmatrix} + \begin{bmatrix} E_1 \\ E_2 \\ \vdots \\ E_{10} \end{bmatrix}.$$

Now X can be partitioned into X_T and X_N where the subscript T refers to the tradable (international) sectors and N stands for the non-tradable (national) sectors. Thus, the system of equations used to solve for x_6, x_7, \dots, x_{10} can be written as

$$\begin{bmatrix} x_T \\ x_N \end{bmatrix} = \begin{bmatrix} A_{TT} & A_{TN} \\ A_{NT} & A_{NN} \end{bmatrix} \begin{bmatrix} x_T \\ x_N \end{bmatrix} + \begin{bmatrix} F_T \\ F_N \end{bmatrix},$$

i.e.,

$$X_T = A_{TT}X_T + A_{TN}X_N + F_T. \quad (1)$$

$$X_N = A_{NT}X_T + A_{NN}X_N + F_N. \quad (2)$$

From (2) we derive

$$(I - A_{NN})X_N = A_{NT}X_T + F_N. \quad (3)$$

$$\therefore X_N = (I - A_{NN})^{-1}(A_{NT}X_T + F_N). \quad (4)$$

Since the expansion in one international sector is assumed to unity and all other international sector expansion is set to zero, matrix X_T in (4) can be replaced by I_T and we have

$$X_N = (I - A_{NN})^{-1}(A_{NT}I_T + F_N). \tag{5}$$

Assuming F_N is set to zero, we finally have

$$X_N = (I - A_{NN})^{-1}A_{NT}. \tag{6}$$

Reference to Appendix Table II gives the matrix $(I - A_{NN})^{-1}$.

APPENDIX TABLE I
INPUT-OUTPUT COEFFICIENTS (α_{ij}) FOR PAPUA NEW GUINEA (1970)

	1	2	3	4	5	6	7	8	9	10
1	0.0198	0	0.0713	0	0.0007	0	0	0	0.0026	0
2	0.001	0	0.0337	0	0.0004	0.0003	0	0	0.004	0
3	0.0732	0.0205	0.0350	0.0196	0.0376	0.2315	0.1495	0.0015	0.0271	0
4	0.0455	0.0893	0.1127	0.0088	0.0340	0.0536	0.0516	0.0514	0.0038	0
5	0.0150	0.0298	0.0318	0.1607	0	0.0480	0.0344	0.0257	0.0257	0
6	0.0034	0	0.0015	0.0077	0.0018	0.0041	0.0026	0.0015	0.0734	0
7	0.0384	0.0186	0.0277	0.0179	0.2506	0.0247	0.0446	0.0589	0.0821	0
8	0.0008	0.0056	0.0077	0.0074	0.1491	0.0010	0.0018	0	0.0131	0
9	0.0081	0.0670	0.0014	0.0872	0.2056	0.0064	0.0070	0.0030	0.0275	0
10	0	0	0	0	0	0	0	0	0	0
Value added	0.7248	0.5460	0.4460	0.6603	0.0195	0.2807	0.5406	0.7009	0.6221	1.00

Source: [5, Table II].

APPENDIX TABLE II
 $(I - A_{NN})^{-1}$ MATRIX

1.0047	0.0033	0.0015	0.0761	0.0
0.0266	1.0475	0.0615	0.0913	0.0
0.0011	0.002	1.0001	0.0137	0.0
0.0068	0.0076	-0.0026	1.0294	0.0
0.00	0.0	0.0	0.0	1.00

Source: [5, Table III C].

APPENDIX TABLE III

SECTOR SHARES OF (PUBLIC AND PRIVATE) CONSUMPTION IN VALUE ADDED

Sector	γ_i
1	0.014
2	0.003
3	0.056
4	0.038
5	0.00
6	0.00
7	0.119
8	0.003
9	0.27
10	0.34
<hr/>	
$\sum_{i=1}^{10} \gamma_i =$	0.7501
	0.2498

Sources: [11, Table 5] [5, Table II].

Notes: 1. Because of the non-availability of sectoral MPC figures for Papua New Guinea, data in Table VI were used to generate sectoral shares of consumption in value added, e.g., for sectoral, $\gamma_1 = 8.06/539.96 = 0.014$. The derived figures for the MPCs for Papua New Guinea were compared to Table 5 in [11] and Table 3-9 in [7]. Whilst comparisons were difficult because of different sector classifications, the calculated figures seemed to be realistic.

2. σ is found using equation (14).

APPENDIX TABLE IV

PARTIAL INCREMENTAL CAPITAL-OUTPUT RATIOS (β_{ij})

Sectors	1	2	3	4	5	6	7	8	9	10
3	0.1378	1.2576	0.942	0	0.1	0.3267	2.6549	2.8279	1.2739	0.03
6	0.8442	1.0799	0.9365	0.4	0	0.1307	0	3.8007	2.5477	0.03
9	0.0179	0.1625	0.1213	0.1	0.4	0.0425	0.3452	0.3712	0.1783	0.03
<hr/>										
Sectoral										
C/O ratios	1	2.5	2	0.5	0.5	0.5	3	7	4	0.09

Sources: [5, Table II] [11, Table 6] [7].