KEY SECTOR IDENTIFICATION WITH MULTIPLE

OBJECTIVES: SOME FURTHER RESULTS

by

Geoffrey Tyler

(in collaboration with Alan R. Roe)

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This paper is circulated for discussion purposes only and its contents
should be considered preliminary.

INTRODUCTION

The purpose of the current paper is twofold. Firstly it extends the analysis of an earlier paper by the authors, {Roe and Tyler 1977a}. That paper was based on a semi-aggregated version of the 1970 Social Accounts Matrix (SAM) available for Sri Lanka, which incorporated 12 economic activities. The current paper is based on the full 48 sector accounts, and seeks to examine the implications of the greater disaggregation.

Secondly, this current paper examines in greater depth the problem of key sector analysis when there are multiple objectives and multiple constraints, and shows how the choice problem may be reduced without resource to any specified social welfare weightings.

This paper should be read in conjunction with the earlier paper, and the qualifications and reservations expressed there apply equally to the current paper.

PART 1.   2.   The Full Data System

The SAM collected for Sri Lanka identifies 48 production activities (excluding Government, and domestic service) and gives their input-output structure, the incomes and employment they generate, and the various final demands for their products.

Table 1 gives the correspondence between these 48 activities and the 12 activities used in Roe and Tyler {1977a}. To some degree classification must be arbitary and in particular the distinction between agricultural processing, traditional industry and modern industry is not

Table 1.   2.

Correspondence between the semi-aggregated production activities of
Roe and Tyler (1977a) and the fully disaggregated activities.

Aggregation as in Roe and Tyler (1977a)	Full Disaggregation			
1. Tea	1.	Tea		
2. Rubber	2.	Rubber		
3. Coconut	3.	Coconut		
4. Paddy	4.	Paddy		
5. Other Agriculture	5.	Livestock	7.	Logging & Firewood
	6.	Fishing	8.	Other Agriculture
6. Agric. Processing	10.	Rice Milling	16.	Dessicated coco. & copra
	11.	Flour Milling	17.	Other Processed Foods
	12.	Dairy Products	18.	Distilling, blending, etc.
	13.	Bread	27.	Coconut Fibre & Yarn
	14.	Other Bakery Pdct.		
7. Mining	9.	Mining		
8. Traditional Industry	19.	Tobacco Pdcts.	26.	Oils and Fats
	20.	Textiles	30.	Ceramics
	21.	Wood Prodts.		
	23.	Leather & Prds.		
	24.	Rubber Pdcts.		
9. Modern Industry	15.	Carbonated Beverage	33.	Light Engineering
	22.	Paper & Paper Pdcts.	34.	Transport Equipment
	25.	Chemicals & Pdcts.	35.	Machinery etc.
	28.	Petroleum & Coal Pdcts.	36.	Manufactures n.e.s.
	32.	Basic Metals	38.	Electricity
10. Construction	29.	Structural Clay Pdcts.	37.	Construction
	31.	Cement & Pdts.		
11. Trade & Transport	39.	Road Passenger Trans.	42.	Retail Trade
	40.	Rail Trans.	43.	Other Transport
	41.	Wholesale Trade	44.	Communications
12. Services	45.	Hotels, Restaurants	47.	Dwellings
	46.	Prof. Services	48.	Other Services

clear cut. Even with the fully disaggregated data, some activities identified may comprise of production units based on local agricultural products, on imported products, and may utilise 'traditional' or very modern methods. Thus 'Tobacco' includes both modern cigarette manufacture and the traditional hand rolling of bedi leaves.

The data of the full SAM is given in Pyatt, Roe et al {1977}. In Table 2 we present the direct coefficients of various "objectives" generated per unit of gross output of each of the production activities. Thus, for example every 1000 Rupees of tea produced in 1970 required 196 Rupees of domestic material inputs and it generated 616 of household income, 63Rs of retained profits and 33Rs of government revenue. At the same time it sustained the employment of .703 workers.

Table 3 gives the rankings of the 48 sectors by the size of the direct coefficients for each objective and it is clear from this that there is a great deal of variation amongst sectors that form a single activity in the semi-aggregated SAM.

Within "agricultural processing", for example, coconut fibre and yarn ranks 15th from the point of view of 'value added' generation, but dessicated coconut and copra ranks 48th.

Within "modern industry" electricity ranks 10th, while transport equipment ranks 44th.

This serves to emphasise the problems of aggregation in analysis and planning. For not only does our semi-aggregated model 'hide' the range

TABLE 2 : DIRECT EFFECTS OF ONE UNIT OF SECTORAL EXPANSION ON VARIOUS OBJECTIVES

	URBAN INCOME	RURAL INCOME	ESTATE INCOME	TOTAL HOUSEHOLD INCOME	OTHER INCOMES	VALUE-ADDED	GOVERNMENT REVENUE	SAVINGS	IMPORTS	EMPLOYMENT	GROSS OUTPUT
1. TEA	0.049	-0.103	0.464	0.616	0.063	0.679	0.033	0.000	0.087	0.703	0.196
2. RUBBER	0.107	0.382	0.189	0.678	0.177	0.856	0.011	0.000	0.032	0.510	0.102
3. COCONUT	0.213	0.314	0.032	0.559	0.357	0.917	0.024	0.000	0.017	0.090	0.042
4. PADDY	-0.011	0.945	-0.000	0.934	-0.071	0.862	0.004	0.000	0.026	0.635	0.105
5. LIVESTOCK	0.191	0.330	0.021	0.542	0.281	0.823	0.023	0.000	0.019	0.028	0.135
6. FISH	0.361	0.356	0.003	0.720	0.226	0.946	0.004	0.000	0.015	0.195	0.035
7. LOGGING AND FIREWOOD	0.182	0.757	0.000	0.939	0.030	0.969	0.001	0.000	0.000	0.050	0.031
8. OTHER AGRIC	0.180	0.345	0.008	0.533	0.293	0.827	0.010	0.000	0.037	0.187	0.126
9. MINING	0.179	0.310	0.002	0.491	0.296	0.787	0.019	0.000	0.028	0.196	0.167
10. RICE MILLING	0.010	0.008	0.000	0.019	0.014	0.032	0.002	0.000	0.003	0.005	0.963
11. FLOUR MILLING	0.173	0.133	0.008	0.314	0.234	0.548	0.003	0.000	0.419	0.087	0.032
12. DAIRY PRODUCTS	0.040	0.051	0.004	0.095	0.022	0.117	0.065	0.000	0.519	0.044	0.299
13. BREAD	0.083	0.095	0.006	0.184	0.056	0.240	0.065	0.000	0.525	0.077	0.173
14. OTHER BAKERY	0.128	0.138	0.011	0.277	0.107	0.384	0.113	0.000	0.219	0.103	0.283
15. CARBONATED BEVERAGES	0.178	0.153	0.002	0.332	0.239	0.571	0.000	0.000	0.214	0.050	0.214
16. DESSICATED COCONUT & COPRA	0.003	0.002	0.000	0.005	0.002	0.007	0.003	0.000	0.000	0.003	0.993
17. OTHER PROCESSED FOOD	0.043	0.068	0.005	0.116	0.084	0.200	0.403	0.000	0.144	0.070	0.248
18. DISTILLING	0.175	0.119	0.002	0.296	0.271	0.568	0.014	0.000	0.054	0.062	0.365
19. TOBACCO PRODUCTS	0.091	0.114	0.001	0.206	0.122	0.328	0.519	0.000	0.012	0.097	0.141
20. TEXTILES	0.095	-0.267	-0.003	0.364	-0.013	0.352	0.115	0.000	0.360	0.335	0.173
21. WOOD PRODUCTS	0.127	0.458	-0.000	0.586	-0.109	0.477	0.001	0.000	0.008	0.381	0.515
22. PAPER	0.203	0.176	0.001	0.380	0.143	0.522	0.115	0.000	0.146	0.095	0.217
23. LEATHER &'c	0.157	0.113	0.001	0.271	0.075	0.346	0.055	0.000	0.077	0.062	0.519
24. RUBBER &'c	0.241	0.121	0.000	0.362	0.147	0.509	0.057	0.000	0.057	0.125	0.377
25. CHEMICALS	0.152	0.086	0.002	0.239	0.176	0.416	0.137	0.000	0.165	0.052	0.282
26. OILS & FATS	0.011	0.007	0.000	0.019	0.004	0.023	0.000	0.000	0.005	0.003	0.972
27. COCONUT FIBRE & YARN	0.071	0.588	0.075	0.734	0.028	0.763	0.000	0.000	0.000	0.063	0.237
28. PETROLEUM PRODUCTS	0.056	0.030	0.001	0.087	0.217	0.304	0.003	0.000	0.000	0.010	0.596
29. STRUCTURAL CLAY PRODUCTS	0.200	0.468	0.001	0.669	0.093	0.762	0.001	0.000	0.000	0.305	0.235
30. CERAMICS	0.100	0.445	-0.001	0.544	0.007	0.552	0.103	0.000	0.138	0.321	0.207
31. CEMENT	0.030	0.042	0.000	0.072	0.267	0.339	0.102	0.000	0.068	0.021	0.492
32. BASIC METALS	0.119	0.112	0.005	0.235	0.053	0.288	0.223	0.000	0.339	0.092	0.153
33. LIGHT ENGINEERING	0.129	0.088	0.002	0.218	0.203	0.421	0.117	0.000	0.176	0.020	0.286
34. TRANSPORT EQUIPMENT	0.128	0.051	-0.000	0.179	-0.022	0.157	0.215	0.000	0.314	0.069	0.314
35. MACHINERY	0.170	0.075	0.001	0.247	0.162	0.409	0.161	0.000	0.269	0.043	0.161
36. OTHER MANUFACTURING	0.174	0.318	0.003	0.496	0.017	0.513	0.026	0.000	0.128	0.218	0.333
37. CONSTRUCTION	0.166	0.145	0.004	0.315	0.246	0.561	0.033	0.000	0.037	0.057	0.364
38. ELECTRICITY	0.227	0.215	0.005	0.447	0.378	0.825	0.013	0.000	0.026	0.125	0.132
39. ROAD PASSENGER TRANSPORT	0.260	0.262	0.005	0.527	0.103	0.629	0.049	0.000	0.057	0.118	0.264
40. RAIL TRANSPORT	0.257	0.330	0.005	0.592	0.054	0.646	-0.049	0.000	0.118	0.176	0.285
41. WHOLESALE TRADE	0.286	0.194	0.003	0.484	0.372	0.856	0.075	0.000	0.006	0.052	0.063
42. RETAIL TRADE	0.318	0.455	0.011	0.784	0.131	0.916	0.047	0.000	0.001	0.307	0.035
43. OTHER TRANSPORT	0.280	0.266	0.005	0.551	0.249	0.799	0.027	0.000	0.036	0.113	0.135
44. COMMUNICATIONS	0.237	0.396	0.002	0.635	0.111	0.746	0.003	0.000	0.038	0.181	0.215
45. HOTELS &'c	0.167	0.216	0.002	0.385	0.082	0.467	0.003	0.000	0.000	0.192	0.533
46. PROFESSIONAL SERVICES	0.313	0.276	0.012	0.601	0.182	0.784	0.021	0.000	0.030	0.105	0.165
47. DWELLINGS	0.257	0.506	0.046	0.808	0.109	0.917	0.022	0.000	0.000	0.000	0.061
48. OTHER SERVICES	0.240	0.280	0.015	0.535	0.013	0.548	0.113	0.000	0.238	0.319	0.105

TABLE 3 : RANKING OF SECTORS BY SIZE OF DIRECT EFFECTS ON VARIOUS OBJECTIVES

	URBAN INCOME	RURAL INCOME	ESTATE INCOME	TOTAL HOUSEHOLD INCOME	OTHER INCOMES	VALUE-ADDED	GOVERNMENT REVENUE	IMPORTS	EMPLOYMENT	GROSS OUTPUT
1. TEA	41.000	36.000	1.000	10.000	32.000	18.000	21.000	18.000	1.000	27.000
2. RUBBER	34.000	10.000	2.000	7.000	17.000	8.000	32.000	28.000	3.000	41.000
3. COCONUT	13.000	16.000	5.000	14.000	3.000	4.000	25.000	34.000	26.000	44.000
4. PADDY	48.000	1.000	47.000	2.000	47.000	6.000	34.000	32.000	2.000	39.000
5. LIVESTOCK	16.000	14.000	6.000	17.000	6.000	11.000	26.000	33.000	41.000	35.000
6. FISH	1.000	11.000	24.000	6.000	13.000	2.000	35.000	35.000	12.000	46.000
7. LOGGING AND FIREWOOD	17.000	2.000	43.000	1.000	36.000	1.000	37.000	44.000	37.000	48.000
8. OTHER AGRIC	18.000	12.000	12.000	19.000	5.000	9.000	33.000	26.000	14.000	38.000
9. MINING	19.000	17.000	27.000	22.000	4.000	13.000	29.000	30.000	11.000	30.000
10. RICE MILLING	46.000	46.000	39.000	46.000	40.000	46.000	36.000	40.000	45.000	3.000
11. FLOUR MILLING	23.000	30.000	11.000	31.000	12.000	25.000	38.000	3.000	27.000	47.000
12. DAIRY PRODUCTS	43.000	43.000	20.000	43.000	38.000	45.000	16.000	2.000	39.000	14.000
13. BREAD	38.000	37.000	13.000	40.000	33.000	42.000	15.000	1.000	28.000	29.000
14. OTHER BAKERY	30.000	29.000	10.000	33.000	26.000	35.000	11.000	9.000	22.000	15.000
15. CARBONATED BEVERAGES	20.000	27.000	29.000	29.000	11.000	21.000	39.000	10.000	38.000	25.000
16. DESSICATED COCONUT & COPRA	47.000	48.000	41.000	48.000	44.000	48.000	40.000	47.000	47.000	1.000
17. OTHER PROCESSED FOOD	42.000	41.000	16.000	42.000	29.000	43.000	2.000	14.000	29.000	20.000
18. DISTILLING	21.000	32.000	26.000	32.000	7.000	22.000	31.000	23.000	32.000	10.000
19. TOBACCO PRODUCTS	37.000	33.000	34.000	39.000	23.000	39.000	1.000	36.000	23.000	34.000
20. TEXTILES	36.000	20.000	25.000	28.000	45.000	36.000	8.000	4.000	5.000	28.000
21. WOOD PRODUCTS	32.000	6.000	45.000	13.000	48.000	30.000	41.000	37.000	4.000	7.000
22. PAPER	14.000	26.000	35.000	26.000	21.000	27.000	9.000	13.000	24.000	23.000
23. LEATHER &'c	27.000	34.000	37.000	34.000	31.000	37.000	17.000	19.000	33.000	6.000
24. RUBBER &'c	9.000	31.000	40.000	27.000	20.000	29.000	18.000	22.000	18.000	9.000
25. CHEMICALS	28.000	39.000	32.000	36.000	18.000	33.000	6.000	12.000	36.000	18.000
26. OILS & FATS	45.000	47.000	44.000	47.000	43.000	47.000	42.000	39.000	46.000	2.000
27. COCONUT FIBRE & YARN	39.000	3.000	3.000	5.000	37.000	15.000	43.000	43.000	31.000	22.000
28. PETROLEUM PRODUCTS	40.000	45.000	38.000	44.000	14.000	40.000	44.000	46.000	44.000	4.000
29. STRUCTURAL CLAY PRODUCTS	15.000	5.000	36.000	8.000	28.000	16.000	45.000	42.000	9.000	21.000
30. CERAMICS	35.000	8.000	48.000	16.000	42.000	24.000	12.000	15.000	6.000	26.000
31. CEMENT	44.000	44.000	42.000	45.000	8.000	38.000	13.000	20.000	42.000	8.000
32. BASIC METALS	33.000	35.000	14.000	37.000	35.000	41.000	3.000	5.000	25.000	33.000
33. LIGHT ENGINEERING	29.000	38.000	30.000	38.000	15.000	32.000	7.000	11.000	43.000	16.000
34. TRANSPORT EQUIPMENT	31.000	42.000	46.000	41.000	46.000	44.000	4.000	6.000	30.000	13.000
35. MACHINERY	24.000	40.000	33.000	35.000	19.000	34.000	5.000	7.000	40.000	32.000
36. OTHER MANUFACTURING	22.000	15.000	23.000	21.000	39.000	28.000	24.000	16.000	10.000	12.000
37. CONSTRUCTION	26.000	28.000	21.000	30.000	10.000	23.000	22.000	25.000	34.000	11.000
38. ELECTRICITY	12.000	24.000	17.000	24.000	1.000	10.000	30.000	31.000	17.000	37.000
39. ROAD PASSENGER TRANSPORT	6.000	22.000	19.000	20.000	27.000	20.000	19.000	21.000	19.000	19.000
40. RAIL TRANSPORT	8.000	13.000	18.000	12.000	34.000	19.000	48.000	17.000	16.000	17.000
41. WHOLESALE TRADE	4.000	25.000	22.000	23.000	2.000	7.000	14.000	38.000	35.000	42.000
42. RETAIL TRADE	2.000	7.000	9.000	4.000	22.000	5.000	20.000	41.000	8.000	45.000
43. OTHER TRANSPORT	5.000	21.000	15.000	15.000	9.000	12.000	23.000	27.000	20.000	36.000
44. COMMUNICATIONS	11.000	9.000	31.000	9.000	24.000	17.000	46.000	24.000	15.000	24.000
45. HOTELS &'c	25.000	23.000	28.000	25.000	30.000	31.000	47.000	45.000	13.000	5.000
46. PROFESSIONAL SERVICES	3.000	19.000	8.000	11.000	16.000	14.000	28.000	29.000	21.000	31.000
47. DWELLINGS	7.000	4.000	4.000	3.000	25.000	3.000	27.000	48.000	48.000	43.000
48. OTHER SERVICES	10.000	18.000	7.000	13.000	41.000	26.000	10.000			40.000

of characteristics of the component fully disaggregated sectors, but each of our 48 sectors in turn will consist of many smaller operating units with equally varied characteristics. Because of this aggregation problem, our 48 sectors cannot be seen as operational units with given characteristics, but rather as guides to a range of much smaller operational units within which there is a high probability of finding characteristics similar to those of the aggregated SAM activity.

While itself an aggregation of operational units, the 48 sector model does generate a greater diversity of characteristics than the semi aggregated model. This is indicated by the maximum and average distance between coefficients as defined in Roe and Tyler {1977a p.19} and shown in Table 4.

Since both distance measures are ratios they make no sense where negative or zero coefficients arise; but taking the value added objective, which is positive for all the 48 activities, the activity yielding the most value added per unit of gross output, when only direct effects are considered (Logging and Firewood), is 138.4 times as "creative" in this respect as the lowest ranking sector (Dessicated Coconut and Copra). On average each sector's value added coefficient, in the rank order, exceeds the one below it by 16.2%. This average distance between each of 48 sectors, compares with 25% between each of only 12 sectors in the semi-aggregated system, and a maximum distance there of 7.33.

Table 4.

Distance Between Sectors from the Viewpoint of Various Objectives*

Effect Considered / Objective	Direct		Direct + Intermediate†		Direct + Total Indirect		Total Effect Normalised w.r.t. Imports	
	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average
Urban Income			371.00	1.603	3.11	1.025	9.35	1.052
Rural Income	472.5	1.195	9.25	1.050	5.77	1.039	9.81	1.052
Estate Income					60.63	1.111	61.81	1.104
Total Household Income	187.8	1.178	3.84	1.029	3.97	1.030	7.79	1.047
Other Institutions Inc.					5.39	1.038	25.22	1.079
Value Added	138.4	1.162	2.63	1.021	3.20	1.025	11.31	1.056
Government Revenue					7.54	1.047	37.53	1.101
Savings (Household)					3.76		7.88	1.048
Imports			13.68	1.115	6.13	1.041		
Employment	234.3		104.28	1.169	7.16	1.044	12.12	1.056
Gross Output	1.9	1.000	2.84	1.024	2.46	1.020	11.97	1.058

*Gap implies effect from expansion of some activities was 0 or negative – therefore measure not applicable.

†The meanings of Intermediate and Indirect effects are defined subsequently and also in Roe and Tyler (1977 pp.6-11).

7.

3. Indirect Repercussions

The problems of key sector analysis arise not only from the multiplicity of objectives, but also from some ambiguity as to the degree of interdependence between sectors which should be taken account of. Within a general equilibrium, competitive theoretical framework, with an open, free-trading world economy, in which all products can be traded internationally, the respective outputs of each activity are in principle independent despite actual flows of output between sectors.

However, in the operating context of most economies output is constrained by effective domestic demand. Markets are imperfect, economies are only partially open to international trade, factors are immobile. In such a context expanding one sector will generate demand for the products of the other domestic sectors.

Roe and Tyler {1977a} pp.6-11 present a standard generalisation of such repercussions in the context of no constraints on capacity, and fixed, linear input/output, and income/expenditure coefficients. The indirect repercussions are separated into "intermediate" effects arising from the generation of intermediate demands on other sectors due to higher output in the originally expanding sector, and "induced" effects arising out of higher consumption demand due to higher incomes being generated by the higher output.

In Tables 5 and 6 we present the coefficients of direct and intermediate repercussions alone, and of direct and indirect repercussions following a one unit expansion of gross output by each of the 48 activities. Incorporating such indirect repercussions clearly leads to substantially higher coefficients than those shown in Table 2. In Tables 7 and 8

TABLE 5 : DIRECT plus INDIRECT EFFECTS of ONE UNIT OF SECTORAL EXPANSION

	URBAN INCOME	RURAL INCOME	ESTATE INCOME	TOTAL HOUSEHOLD INCOME	OTHER INCOMES	VALUE-ADDED	GOVERNMENT REVENUE	IMPORTS	EMPLOYMENT	GROSS OUTPUT
1. TEA	0.099	0.164	0.465	0.727	0.110	0.837	0.054	0.108	0.730	0.2
2. RUBBER	0.132	0.404	0.190	0.726	0.207	0.932	0.022	0.046	0.520	0.1
3. COCONUT	0.224	0.324	0.032	0.580	0.367	0.948	0.029	0.026	0.096	0.0
4. PADDY	0.001	1.017	-0.000	1.017	-0.065	0.953	0.011	0.036	0.683	0.1
5. LIVESTOCK	0.220	0.364	0.024	0.607	0.321	0.929	0.044	0.028	0.041	0.29
6. FISH	0.371	0.363	0.003	0.737	0.239	0.976	0.005	0.018	0.199	0.0
7. LOGGING AND FIREWOOD	0.190	0.763	0.000	0.953	0.039	0.993	0.003	0.004	0.052	0.03
8. OTHER AGRIC	0.208	0.384	0.009	0.601	0.333	0.933	0.015	0.048	0.208	0.15
9. MINING	0.220	0.357	0.003	0.579	0.347	0.927	0.029	0.044	0.211	0.22
10. RICE MILLING	0.025	0.950	0.001	0.976	-0.031	0.945	0.015	0.040	0.635	1.09
11. FLOUR MILLING	0.183	0.140	0.009	0.331	0.246	0.578	0.003	0.420	0.089	0.03
12. DAIRY PRODUCTS	0.109	0.150	0.010	0.270	0.120	0.389	0.083	0.530	0.060	0.37
13. BREAD	0.127	0.139	0.007	0.272	0.105	0.377	0.075	0.547	0.091	0.19
14. OTHER BAKERY	0.202	0.212	0.013	0.427	0.202	0.629	0.131	0.240	0.132	0.45
15. CARBONATED BEVERAGES	0.232	0.195	0.003	0.430	0.317	0.747	0.017	0.234	0.067	0.25
16. DESSICATED COCONUT & COPRA	0.235	0.313	0.029	0.577	0.365	0.942	0.034	0.024	0.096	1.06
17. OTHER PROCESSED FOOD	0.112	0.144	0.009	0.265	0.168	0.432	0.417	0.150	0.096	0.46
18. DISTILLING	0.273	0.192	0.004	0.470	0.417	0.887	0.032	0.082	0.097	0.53
19. TOBACCO PRODUCTS	0.125	0.160	0.002	0.287	0.169	0.455	0.523	0.020	0.119	0.16
20. TEXTILES	0.135	0.314	0.003	0.452	0.028	0.480	0.131	0.389	0.368	0.21
21. WOOD PRODUCTS	0.264	0.747	0.001	1.013	-0.049	0.964	0.016	0.020	0.543	0.738
22. PAPER	0.255	0.236	0.002	0.493	0.205	0.698	0.134	0.168	0.125	0.277
23. LEATHER &'c	0.297	0.256	0.007	0.560	0.225	0.785	0.093	0.117	0.110	0.733
24. RUBBER &'c	0.323	0.232	0.030	0.590	0.253	0.837	0.083	0.083	0.225	0.491
25. CHEMICALS	0.225	0.157	0.004	0.386	0.261	0.648	0.162	0.199	0.083	0.469
26. OILS & FATS	0.246	0.304	0.026	0.576	0.360	0.936	0.033	0.028	0.096	1.933
27. COCONUT FIBRE & YARN	0.124	0.659	0.081	0.864	0.118	0.982	0.007	0.009	0.083	0.324
28. PETROLEUM PRODUCTS	0.205	0.129	0.003	0.337	0.634	0.971	0.013	0.016	0.049	1.882
29. STRUCTURAL CLAY PRODUCTS	0.261	0.554	0.002	0.817	0.168	0.985	0.013	0.006	0.329	0.310
30. CERAMICS	0.153	0.500	-0.000	0.653	0.091	0.744	0.111	0.145	0.348	0.303
31. CEMENT	0.129	0.155	0.002	0.285	0.450	0.736	0.148	0.117	0.081	0.688
32. BASIC METALS	0.153	0.141	0.006	0.299	0.104	0.404	0.235	0.360	0.103	0.223
33. LIGHT ENGINEERING	0.197	0.144	0.003	0.344	0.277	0.621	0.155	0.224	0.045	0.355
34. TRANSPORT EQUIPMENT	0.214	0.161	0.001	0.376	0.046	0.422	0.241	0.338	0.134	0.432
35. MACHINERY	0.214	0.110	0.002	0.326	0.214	0.540	0.177	0.283	0.057	0.205
36. OTHER MANUFACTURING	0.260	0.406	0.004	0.670	0.108	0.778	0.053	0.164	0.261	0.428
37. CONSTRUCTION	0.252	0.261	0.005	0.518	0.344	0.862	0.069	0.069	0.122	0.496
38. ELECTRICITY	0.259	0.240	0.005	0.505	0.422	0.927	0.031	0.042	0.134	0.177
39. ROAD PASSENGER TRANSPORT	0.329	0.315	0.007	0.651	0.193	0.843	0.073	0.084	0.145	0.392
40. RAIL TRANSPORT	0.333	0.395	0.006	0.734	0.150	0.884	0.025	0.141	0.203	0.378
41. WHOLESALE TRADE	0.303	0.215	0.004	0.522	0.388	0.909	0.073	0.012	0.065	0.085
42. RETAIL TRADE	0.328	0.466	0.012	0.805	0.141	0.946	0.049	0.005	0.312	0.046
43. OTHER TRANSPORT	0.316	0.294	0.006	0.616	0.290	0.906	0.042	0.051	0.129	0.190
44. COMMUNICATIONS	0.300	0.466	0.003	0.769	0.163	0.932	0.012	0.056	0.217	0.267
45. HOTELS &'c	0.264	0.431	0.010	0.705	0.192	0.897	0.042	0.061	0.301	0.708
46. PROFESSIONAL SERVICES	0.358	0.327	0.012	0.698	0.222	0.920	0.034	0.046	0.130	0.221
47. DWELLINGS	0.272	0.521	0.046	0.840	0.130	0.970	0.025	0.004	0.007	0.091
48. OTHER SERVICES	0.272	0.316	0.016	0.604	0.037	0.641	0.116	0.244	0.336	0.136

TABLE 6 : DIRECT plus INDIRECT plus INDUCED EFFECTS of ONE UNIT OF SECTORAL EXPANSION

	URBAN INCOME	RURAL INCOME	ESTATE INCOME	TOTAL HOUSEHOLD INCOME	OTHER INCOMES	VALUE-ADDED	GOVERNMENT REVENUE	SAVINGS	IMPORTS	EMPLOYMENT	GROSS OUTPUT
1. TEA	0.330	0.623	0.485	1.439	0.298	1.737	0.191	0.137	0.374	0.991	1.693
2. RUBBER	0.357	0.847	0.208	1.412	0.387	1.799	0.165	0.164	0.284	0.768	1.513
3. COCONUT	0.399	0.658	0.045	1.102	0.505	1.607	0.154	0.146	0.195	0.281	1.096
4. PADDY	0.316	1.651	0.023	1.990	0.189	2.179	0.204	0.248	0.360	1.038	2.091
5. LIVESTOCK	0.403	0.715	0.037	1.155	0.465	1.621	0.174	0.154	0.207	0.236	1.392
6. FISH	0.590	0.775	0.019	1.384	0.409	1.793	0.172	0.193	0.226	0.426	1.345
7. LOGGING AND FIREWOOD	0.481	1.332	0.022	1.835	0.270	2.105	0.197	0.239	0.294	0.369	1.503
8. OTHER AGRIC	0.389	0.732	0.022	1.143	0.475	1.618	0.147	0.153	0.225	0.400	1.243
9. MINING	0.394	0.690	0.016	1.100	0.484	1.584	0.155	0.149	0.212	0.396	1.263
10. RICE MILLING	0.327	1.554	0.023	1.905	0.212	2.117	0.201	0.239	0.349	0.973	2.969
11. FLOUR MILLING	0.281	0.323	0.016	0.620	0.323	0.943	0.075	0.086	0.513	0.190	0.511
12. DAIRY PRODUCTS	0.190	0.305	0.016	0.511	0.183	0.694	0.139	0.069	0.609	0.145	0.862
13. BREAD	0.208	0.292	0.013	0.514	0.169	0.682	0.135	0.070	0.625	0.176	0.673
14. OTHER BAKERY	0.330	0.453	0.023	0.805	0.302	1.107	0.225	0.110	0.362	0.265	1.206
15. CARBONATED BEVERAGES	0.359	0.434	0.012	0.806	0.416	1.221	0.117	0.113	0.354	0.199	1.307
16. DESSICATED COCONUT & COPRA	0.409	0.643	0.042	1.093	0.501	1.595	0.157	0.146	0.193	0.279	2.094
17. OTHER PROCESSED FOOD	0.191	0.295	0.015	0.501	0.230	0.731	0.475	0.068	0.227	0.179	0.937
18. DISTILLING	0.412	0.451	0.014	0.877	0.524	1.401	0.143	0.124	0.212	0.239	1.347
19. TOBACCO PRODUCTS	0.210	0.323	0.008	0.542	0.236	0.777	0.583	0.074	0.102	0.209	0.673
20. TEXTILES	0.272	0.578	0.013	0.863	0.136	0.999	0.225	0.115	0.523	0.515	1.338
21. WOOD PRODUCTS	0.572	1.345	0.024	1.940	0.194	2.134	0.225	0.256	0.323	0.873	2.597
22. PAPER	0.402	0.510	0.012	0.924	0.319	1.243	0.245	0.129	0.307	0.276	1.138
23. LEATHER &'c	0.463	0.567	0.019	1.050	0.354	1.404	0.225	0.146	0.274	0.281	1.711
24. RUBBER &'c	0.496	0.556	0.043	1.095	0.388	1.483	0.213	0.151	0.248	0.403	1.510
25. CHEMICALS	0.339	0.369	0.012	0.720	0.350	1.070	0.251	0.102	0.297	0.199	1.135
26. OILS & FATS	0.419	0.632	0.039	1.090	0.496	1.586	0.161	0.147	0.196	0.277	2.961
27. COCONUT FIBRE & YARN	0.391	1.185	0.101	1.676	0.331	2.007	0.183	0.207	0.282	0.377	1.957
28. PETROLEUM PRODUCTS	0.304	0.313	0.010	0.627	0.711	1.338	0.091	0.089	0.108	0.150	2.460
29. STRUCTURAL CLAY PRODUCTS	0.507	1.030	0.020	1.557	0.362	1.919	0.183	0.208	0.247	0.593	1.793
30. CERAMICS	0.351	0.887	0.015	1.253	0.248	1.501	0.245	0.165	0.342	0.563	1.507
31. CEMENT	0.214	0.316	0.008	0.539	0.517	1.055	0.211	0.074	0.198	0.170	1.194
32. BASIC METALS	0.242	0.308	0.012	0.562	0.174	0.736	0.304	0.078	0.445	0.195	0.747
33. LIGHT ENGINEERING	0.298	0.333	0.010	0.642	0.356	0.998	0.234	0.091	0.319	0.149	0.949
34. TRANSPORT EQUIPMENT	0.325	0.368	0.010	0.702	0.132	0.834	0.327	0.099	0.442	0.248	1.083
35. MACHINERY	0.310	0.286	0.009	0.605	0.288	0.893	0.254	0.087	0.371	0.154	0.760
36. OTHER MANUFACTURING	0.461	0.790	0.019	1.270	0.266	1.536	0.203	0.172	0.359	0.473	1.628
37. CONSTRUCTION	0.406	0.552	0.016	0.974	0.464	1.439	0.185	0.135	0.216	0.282	1.408
38. ELECTRICITY	0.409	0.522	0.016	0.947	0.539	1.486	0.145	0.132	0.184	0.289	1.360
39. ROAD PASSENGER TRANSPORT	0.523	0.679	0.021	1.222	0.343	1.565	0.217	0.173	0.268	0.345	1.533
40. RAIL TRANSPORT	0.552	0.810	0.022	1.384	0.321	1.706	0.137	0.190	0.351	0.432	1.577
41. WHOLESALE TRADE	0.457	0.502	0.015	0.973	0.507	1.480	0.199	0.138	0.155	0.222	0.986
42. RETAIL TRADE	0.569	0.927	0.029	1.525	0.330	1.855	0.225	0.207	0.238	0.567	1.486
43. OTHER TRANSPORT	0.499	0.638	0.020	1.157	0.432	1.589	0.182	0.161	0.225	0.319	1.269
44. COMMUNICATIONS	0.531	0.907	0.020	1.458	0.344	1.802	0.173	0.198	0.279	0.461	1.645
45. HOTELS &'c	0.476	0.837	0.026	1.339	0.359	1.698	0.194	0.181	0.267	0.525	1.977
46. PROFESSIONAL SERVICES	0.566	0.716	0.028	1.310	0.383	1.693	0.191	0.182	0.244	0.345	1.443
47. DWELLINGS	0.526	1.012	0.065	1.603	0.331	1.934	0.203	0.210	0.256	0.280	1.621

TABLE 7 : TYPE I MULTIPLIERS

	URBAN INCOME	RURAL INCOME	ESTATE INCOME	TOTAL HOUSEHOLD INCOME	OTHER INCOMES	VALUE-ADDED	GOVERNMENT REVENUE	IMPORTS	EMPLOYMENT	GROSS OUTPUT
1. TEA	2.020	1.592	1.002	1.180	1.746	1.233	1.636	1.241	1.038	1.265
2. RUBBER	1.234	1.058	1.005	1.071	1.169	1.089	2.000	1.438	1.020	1.139
3. COCONUT	1.052	1.032	1.000	1.038	1.028	1.034	1.208	1.412	1.067	1.052
4. PADDY	0.091	1.076	1.000	1.089	0.915	1.106	2.750	1.385	1.076	1.132
5. LIVESTOCK	1.152	1.103	1.143	1.120	1.142	1.129	1.913	1.474	1.464	1.296
6. FISH	1.028	1.020	1.000	1.024	1.058	1.032	1.500	1.200	1.021	1.053
7. LOGGING AND FIREWOOD	1.044	1.008	1.000	1.015	1.300	1.025	30.000	40.000	1.040	1.038
8. OTHER AGRIC	1.156	1.113	1.125	1.128	1.137	1.128	1.800	1.297	1.112	1.157
9. MINING	1.229	1.152	1.500	1.179	1.172	1.178	1.526	1.571	1.077	1.222
10. RICE MILLING	2.500	118.750	10.000	51.368	2.214	29.531	7.500	13.333	127.000	2.099
11. FLOUR MILLING	1.058	1.053	1.125	1.054	1.051	1.055	30.000	1.002	1.023	1.035
12. DAIRY PRODUCTS	2.725	2.941	2.500	2.842	5.455	3.325	1.231	1.021	1.364	1.379
13. BREAD	1.530	1.463	1.167	1.478	1.875	1.571	1.154	1.042	1.182	1.191
14. OTHER BAKERY	1.578	1.536	1.182	1.542	1.888	1.638	1.191	1.096	1.282	1.451
15. CARBONATED BEVERAGES	1.303	1.275	1.500	1.295	1.326	1.308	190.000	1.093	1.340	1.258
16. DESSICATED COCONUT & COPRA	78.333	156.500	290.000	115.400	182.500	134.571	340.000	240.000	32.000	2.060
17. OTHER PROCESSED FOOD	2.605	2.118	1.800	2.284	2.000	2.160	1.022	1.042	1.371	1.464
18. DISTILLING	1.560	1.613	2.000	1.588	1.539	1.562	2.286	1.519	1.565	1.536
19. TOBACCO PRODUCTS	1.374	1.404	2.000	1.393	1.385	1.587	1.014	1.667	1.227	1.164
20. TEXTILES	1.421	1.175	1.000	1.242	2.154	1.364	1.139	1.081	1.099	1.214
21. WOOD PRODUCTS	2.079	1.631	10.000	1.729	0.450	2.021	160.000	2.500	1.425	1.738
22. PAPER	1.256	1.341	2.000	1.297	1.434	1.337	1.165	1.151	1.316	1.277
23. LEATHER &'c	1.892	2.265	7.000	2.066	3.000	2.269	1.690	1.519	1.774	1.733
24. RUBBER &'c	1.340	1.917	300.000	1.630	1.721	1.644	1.404	1.456	1.800	1.491
25. CHEMICALS	1.480	1.826	2.000	1.615	1.483	1.558	1.182	1.152	1.596	1.469
26. OILS & FATS	22.364	43.429	260.000	30.316	90.000	40.696	350.000	5.600	32.000	2.933
27. COCONUT FIBRE & YARN	1.746	1.121	1.080	1.177	4.214	1.287	90.000	90.000	1.317	1.324
28. PETROLEUM PRODUCTS	3.661	4.300	3.000	3.874	2.922	3.194	130.000	160.000	4.900	2.882
29. STRUCTURAL CLAY PRODUCTS	1.305	1.184	2.000	1.221	1.806	1.293	100.000	60.000	1.079	1.310
30. CERAMICS	1.530	1.124	0.100	1.200	13.000	1.348	1.078	1.051	1.084	1.303
31. CEMENT	4.300	3.690	20.000	3.958	1.685	2.171	1.451	1.721	3.857	1.688
32. BASIC METALS	1.286	1.259	1.200	1.272	1.962	1.403	1.073	1.062	1.120	1.223
33. LIGHT ENGINEERING	1.527	1.636	1.500	1.578	1.365	1.475	1.325	1.273	2.250	1.355
34. TRANSPORT EQUIPMENT	1.672	3.157	10.000	2.101	2.091	2.688	1.116	1.076	1.942	1.432
35. MACHINERY	1.259	1.467	2.000	1.320	1.321	1.320	1.099	1.052	1.326	1.205
36. OTHER MANUFACTURING	1.494	1.277	1.333	1.351	6.353	1.517	2.231	1.281	1.197	1.428
37. CONSTRUCTION	1.518	1.800	1.250	1.644	1.398	1.537	2.091	1.865	2.140	1.496
38. ELECTRICITY	1.141	1.116	1.000	1.130	1.116	1.124	1.722	1.615	1.072	1.177
39. ROAD PASSENGER TRANSPORT	1.265	1.202	1.400	1.235	1.874	1.340	1.490	1.474	1.229	1.392
40. RAIL TRANSPORT	1.296	1.197	1.200	1.240	2.778	1.368	0.510	1.195	1.153	1.378
41. WHOLESALE TRADE	1.059	1.108	1.333	1.079	1.022	1.062	1.053	2.000	1.250	1.085
42. RETAIL TRADE	1.031	1.024	1.091	1.027	1.076	1.033	1.043	5.000	1.016	1.046
43. OTHER TRANSPORT	1.129	1.105	1.200	1.118	1.165	1.134	1.448	1.417	1.142	1.190
44. COMMUNICATIONS	1.266	1.177	1.500	1.211	1.468	1.249	120.000	1.474	1.199	1.267
45. HOTELS &'c	1.581	1.995	5.000	1.831	2.341	1.921	420.000	610.000	1.568	1.708
46. PROFESSIONAL SERVICES	1.144	1.185	1.000	1.161	1.220	1.173	1.619	1.533	1.238	1.221
47. DWELLINGS	1.058	1.030	1.000	1.040	1.193	1.058	1.136	40.000	70.000	1.091
48. OTHER SERVICES	1.113	1.130								

TABLE 8 : TYPE 2 MULTIPLIERS

12.

	URBAN INCOME	RURAL INCOME	ESTATE INCOME	TOTAL HOUSEHOLD INCOME	OTHER INCOMES	VALUE-ADDED	GOVERNMENT REVENUE	IMPORTS	EMPLOYMENT	GROSS OUTPUT
1. TEA	6.735	6.049	1.045	2.336	4.730	2.558	5.788	4.299	1.410	2.698
2. RUBBER	3.336	2.217	1.101	2.083	2.186	2.102	15.000	8.875	1.506	2.515
3. COCONUT	1.873	2.096	1.406	1.971	1.415	1.752	6.417	11.471	3.122	2.096
4. PADDY	23.727	1.747	-230.000	2.131	-2.662	2.528	51.000	13.846	-1.635	3.091
5. LIVESTOCK	2.110	2.167	1.762	2.131	1.655	1.970	7.565	10.895	8.429	2.392
6. FISH	1.634	2.177	-6.333	1.922	1.810	1.895	43.000	15.067	2.185	2.345
7. LOGGING AND FIREWOOD	2.643	1.760	220.000	1.954	9.000	2.172	1970.000	2940.000	7.380	2.808
8. OTHER AGRIC	2.161	2.122	2.750	2.144	1.621	1.956	14.700	6.081	2.139	2.243
9. MINING	2.201	2.226	8.000	2.240	1.635	2.013	8.158	7.571	2.020	2.263
10. RICE MILLING	32.700	194.250	230.000	100.263	15.143	66.156	100.500	116.333	194.600	3.969
11. FLOUR MILLING	1.624	2.429	2.000	1.975	1.380	1.721	780.000	1.224	2.184	1.611
12. DAIRY PRODUCTS	4.750	5.980	4.000	5.379	8.318	5.932	2.138	1.173	3.295	1.862
13. BREAD	2.506	3.074	2.167	2.793	3.018	2.842	2.092	1.190	2.286	1.673
14. OTHER BAKERY	2.578	3.283	2.091	2.906	2.822	2.883	2.055	1.653	2.573	2.206
15. CARBONATED BEVERAGES	2.017	2.837	6.000	2.428	1.741	2.138	1170.000	1.654	3.980	2.007
16. DESSICATED COCONUT & COPRA	36.333	321.500	420.000	218.600	250.500	227.857	1590.000	1930.000	93.000	3.094
17. OTHER PROCESSED FOOD	4.442	4.338	3.000	4.319	2.738	3.655	1.164	1.576	2.557	1.937
18. DISTILLING	2.354	3.790	7.000	2.963	1.934	2.467	10.000	3.926	3.855	2.347
19. TOBACCO PRODUCTS	2.308	2.833	8.000	2.631	1.934	2.369	1.135	8.500	2.155	1.673
20. TEXTILES	2.863	2.165	4.333	2.371	-10.462	2.838	1.965	1.453	1.537	2.035
21. WOOD PRODUCTS	4.504	2.937	-240.000	3.311	-1.780	4.474	2260.000	40.375	2.297	3.597
22. PAPER	1.980	2.898	12.000	2.432	2.231	2.381	2.130	2.103	2.905	2.138
23. LEATHER &'c	2.949	5.018	19.000	3.875	4.720	4.058	3.879	3.558	4.532	2.711
24. RUBBER &'c	2.058	4.595	430.000	3.025	2.639	2.914	3.737	4.351	3.224	2.510
25. CHEMICALS	2.230	4.291	6.000	3.013	1.989	2.572	1.832	1.800	3.827	2.135
26. OILS & FATS	38.091	90.286	390.000	57.368	124.000	68.957	1610.000	39.200	92.333	3.961
27. COCONUT FIBRE & YARN	5.507	2.015	1.347	2.283	11.821	2.630	1800.000	2820.000	5.984	2.957
28. PETROLEUM PRODUCTS	5.429	10.433	10.000	7.207	3.276	4.401	910.000	1080.000	15.000	3.460
29. STRUCTURAL CLAY PRODUCTS	2.535	2.201	20.000	2.327	3.892	2.518	1830.000	2470.000	1.944	2.793
30. CERAMICS	3.510	1.993	-15.000	2.303	35.429	2.719	2.388	2.478	1.754	2.507
31. CEMENT	7.133	7.524	80.000	7.486	1.936	3.112	2.069	2.912	8.095	2.194
32. BASIC METALS	2.034	2.750	2.400	2.391	3.283	2.556	1.382	1.313	2.120	1.747
33. LIGHT ENGINEERING	2.310	3.784	5.000	2.945	1.754	2.371	2.000	1.813	7.450	1.949
34. TRANSPORT EQUIPMENT	2.539	7.216	-100.000	3.922	-6.000	5.312	1.514	1.408	3.594	2.083
35. MACHINERY	1.824	3.813	9.000	2.449	1.778	2.183	1.578	1.379	3.581	1.760
36. OTHER MANUFACTURING	2.649	2.484	6.333	2.560	15.647	2.994	7.808	2.805	2.170	2.628
37. CONSTRUCTION	2.446	3.807	4.000	3.092	1.886	2.565	5.606	5.838	4.947	2.408
38. ELECTRICITY	1.802	2.428	3.200	2.119	1.426	1.801	8.056	7.077	2.312	2.060
39. ROAD PASSENGER TRANSPORT	2.012	2.592	4.200	2.319	3.330	2.488	4.469	4.702	2.924	2.533
40. RAIL TRANSPORT	2.148	2.455	4.400	2.338	5.944	2.641	2.796	2.975	2.455	2.677
41. WHOLESALE TRADE	1.598	2.588	-5.000	2.010	1.363	1.729	2.653	-26.000	4.269	1.986
42. RETAIL TRADE	1.789	2.037	2.636	1.945	2.519	2.025	4.787	238.000	1.847	2.486
43. OTHER TRANSPORT	1.782	2.398	4.000	2.100	1.735	1.989	6.276	6.250	2.823	2.269
44. COMMUNICATIONS	2.241	2.290	10.000	2.296	3.099	2.416	1790.000	7.342	2.547	2.645
45. HOTELS &'c	2.850	3.875	13.000	3.478	4.378	3.636	1940.000	2670.000	2.734	2.977
46. PROFESSIONAL SERVICES	1.808	2.594	2.333	2.180	2.104	2.159	9.095	8.133	3.286	2.443
47. DWELLINGS	2.047	2.000	1.413	1.984	3.037	2.109	9.227	2560.000	2800.000	2.621
48. OTHER SERVICES	1.383	2.354	1.933	2.131	13.769	2.407	2.255	1.756	1.646	2.205

the direct plus intermediate, and direct plus total indirect coefficients
are expressed as mutiples of the direct effect alone (respectively
'Type I and Type II' multipliers), excluding of course, cases where the
direct effect was negative or zero.   If we consider the value-added
objective, we find a range of 1.025 to 134.6 for the Type I multiplier,
and a range of 1.72 to 227.8 for the Type II multiplier, clearly
demonstrating that in analysing sectors, one cannot dismiss the indirect
repercussions of expansion as being broadly similar whichever sector
undergoes the original expansion.

The value of the "average" multiplier is unaffected by aggregation,
provided the average is weighted by the original 1970 levels of the
objective considered. 1/

1/   The most useful concept of an "average" multiplier is the ratio of
indirect + direct changes in any objective to direct changes
that will follow from raising final demand for all activities
in proportion to their current gross output levels.

At first sight it might be thought that this would be equal to
each activity's individual multiplier, weighted by that
activity's gross output, but in fact it is the equivalent of
the individual multipliers weighted by the absolute value of
the objective being considered.

Taking the case of value added ,we wish to show that activity value
added multipliers, weighted by absolute value added levels is
the same as the total value added multiplier that will follow
from a change in Final Demand in proportion to current gross
output levels.

Footnote 1.   continued ....

Suppose n activities

Let gross output of ith activity $= G_i$

Let value added of ith activity $= VA_i$

then direct value added coefficient of ith activity $= VA_i/G_i$

Let   total gross output $= G = \sum_{i=1}^{n} G_i$

Let total value added $= VA = \sum_{i=1}^{n} VA_i$

Let final demand increase by 1, and be distributed between activities in proportion to current gross outputs. The rise in final demand for the ith activity is G_i/G

thus the direct value added generated, by the ith activity is :

$$\frac{G_i}{G} \quad x \quad \frac{VA_i}{G_i} \quad = \quad \frac{VA_i}{G}$$

.·.   total direct value added generated is :

$$\sum_{i=1}^{n} \quad VA_i/G$$

Let M_i be multiplier for activity i, i.e. ratio of direct and indirect value added to direct value added.

Then the direct plus indirect value added generated by the expansion of activity is i is:

$$VA_i/G \quad x \quad M_i$$

and the total value added generated by all activities is:

$$\sum_{i=1}^{n} \quad VA_i/G \quad x \quad M_i$$

The overall ratio of total direct and indirect value added generated to direct value added generated, by a unit increase in final demand distributed in proportion to current gross output levels is:

$$\frac{\sum_{i=1}^{n} VA_i/G \quad x \quad M_i}{\sum_{i=1}^{n} VA_i/G} \quad = \quad \frac{\sum_{i=1}^{n} VA_i \quad x \quad M_i}{VA}$$

i.e. individual value added multipliers weighted by the absolute levels of value added

Thus the value-added weighted, average value added Type I multiplier is 1.38 and Type II multiplier is 2.59 in both the 12 and 48 sector models. On average, therefore, it is higher consumer expenditure that provides the bulk of indirect repercussions, but at 38% of the direct effect, intermediate effects are still very important.
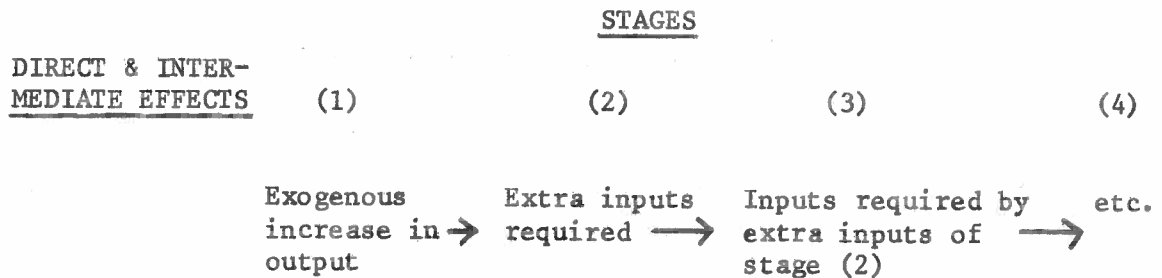
The relative isolation of the estate sector is again displayed, both in the small absolute size of indirect coefficients and in the very small Type I and Type II multipliers for estate income, arising from the expansion of Tea and Rubber where the bulk of estate workers are employed (see col. 3 of Tables 7 and 8). Also it is clear that industrial activities by and large gave a larger multiplier effect than agricultural sectors. However there is a great deal of variation within these sectors, and the overall differences becomes less noticeable when consumption induced repercussions are allowed for.

For example, the Value Added Type I multiplier for electricity is only 1.12 as opposed to 1.56 for modern industry as a whole, and 2.69 for Transport Equipment. While Traditional Industry on average generates greater linkages, with a Type I Value-Added Multiplier of 1.94, this does not apply equally to all component sectors, being 1.35 for Ceramics but 2.27 for Leather and Leather Products.

4. Time Dimension

To satisfactorily evaluate the significance of these generally large indirect effects one would like some idea of the time required for their

emergence following an exogenous demand increase. However, since our model is essentially static, comparing equilibrium states, this is not feasible. But it is possible to record the number of 'rounds' of linkages required to achieve a given proportion of the total effect and this is done below. The stages whereby the overall repercussions are generated are illustrated below:

STAGES

DIRECT & INTER-MEDIATE EFFECTS	(1)	(2)	(3)	(4)

Exogenous increase in → output Extra inputs required → Inputs required by extra inputs of stage (2) → etc.

DIRECT & TOTAL INDIRECT EFFECTS

Exogenous increase in output

Extra inputs required

Extra inputs required

Extra Incomes Generated

etc.

Extra Income Generated

Extra Expenditure Requiring Extra Output

Employment of Domestic Servants
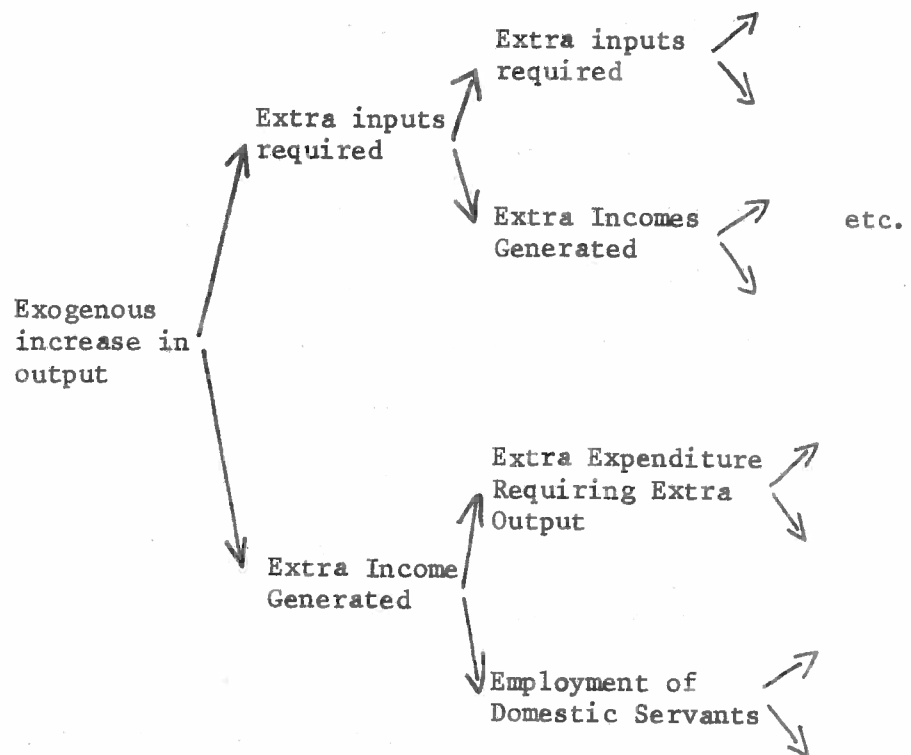
If we take the example of total household income, in the case of direct plus intermediate effects, Round 1 consists of income earned in the initial expansion of activity output, Round 2 is the extra incomes earned in activities which expand to supply inputs to the initially expanded activity, and so on. These two rounds alone account for 80% of the total effect in the case of all 48 sectors, and over 90% for most of them. By Round 5, all but one activity have generated 99% of their total effect on household incomes.

In the case of direct plus total indirect effects, Round 1 is the income earned in the initial expansion of activity output, Round 2 is the extra income earned from supplying extra inputs to the activity and extra labour services to households, Round 3 consists of extra income earned in supplying further inputs to sectors expanded in Round 2, and in meeting the higher expenditure demands arising from the previous income expansions, and so on. By Round 2, at least 40% of the total effect on household income has been generated in the case of all but two of the 48 activities; by Round 5, all but three have generated 75%, and by Round 10, only one activity has generated less than 95% of its total, direct and indirect effect on household incomes.

Recognising the large absolute size of the indirect repercussions and the relatively early stages at which they arise, it is clear that some allowance must be made for them in any medium term planning exercise.

5. Key Sector Evaluation

Problems of Choice arise because of constraints on actions.

In the context of economic expansion, constraints may include labour
supply, balance of payments requirements, capacity, administrative
ability and so on.   In the context of Sri Lanka, the key short term
constraint in recent years has been the balance of payments.   If this
is taken as the only constraint, then activities should be evaluated not
in terms of the total benefits as identified above, but in terms of the
benefits per unit cost to the balance of payments.   Where some sectors
export a whole or part of their product such evaluation is not simple,
since in the absence of any other constraint the foreign exchange constraint
can be completely relaxed by a sufficient expansion of export sectors.
In the full Linear Programming context, a variety of other constraints are
possible, and some steps towards incorporating these are made in section 11.
For the moment we assume no new exports, i.e. we evaluate sectors,
assuming an increase in domestic demand for their product, in terms of
objectives achieved per unit of imports required.

In Table 9 we give the total direct and indirect objectives
achieved per unit of total imports required.   In Tables 10,11&12 we give
the rankings for the various objectives in the case of direct plus
intermediate, direct plus total indirect, and direct plus total indirect
per unit of total imports, effects respectively   In conjunction with
Table 3, we can see how rankings change, both as a more comprehensive
view of repercussions is incorporated and as objectives vary.   Tea, for
example ranks, in terms of value added, 18th by direct effect alone,
29th when all indirect effects are considered, and 32nd when the total
effect is normalised against imports.   In this last case, the rank of

TABLE 9 : DIRECT plus INDIRECT plus INDUCED EFFECTS PER UNIT OF IMPORTS

	URBAN INCOME	RURAL INCOME	ESTATE INCOME	TOTAL HOUSEHOLD INCOME	OTHER INCOMES	VALUE-ADDED	GOVERNMENT REVENUE	SAVINGS	IMPORTS	EMPLOYMENT	GROSS OUTPUT
1. TEA	0.883	1.668	1.298	3.849	0.799	4.648	0.512	0.365	1.000	2.651	4.54
2. RUBBER	1.258	2.987	0.732	4.977	1.365	6.342	0.583	0.577	1.000	2.709	5.35
3. COCONUT	2.048	3.378	0.233	5.659	2.590	8.250	0.791	0.751	1.000	1.442	5.62
4. PADDY	0.879	4.590	0.065	5.533	0.525	6.058	0.565	0.689	1.000	2.885	5.41
5. LIVESTOCK	1.946	3.452	0.179	5.577	2.247	7.825	0.837	0.742	1.000	1.140	6.72
6. FISH	2.612	3.435	0.083	6.131	1.814	7.945	0.763	0.853	1.000	1.887	5.96
7. LOGGING AND FIREWOOD	1.637	4.540	0.074	6.251	0.921	7.172	0.671	0.814	1.000	1.258	6.16
8. OTHER AGRIC	1.728	3.251	0.097	5.077	2.111	7.189	0.651	0.680	1.000	1.779	5.52
9. MINING	1.857	3.249	0.074	5.179	2.276	7.456	0.729	0.701	1.000	1.864	5.94
10. RICE MILLING	0.939	4.459	0.066	5.464	0.607	6.071	0.576	0.684	1.000	2.790	8.51
11. FLOUR MILLING	0.549	0.630	0.031	1.210	0.629	1.839	0.153	0.169	1.000	0.371	1.19
12. DAIRY PRODUCTS	0.313	0.500	0.026	0.839	0.301	1.140	0.223	0.113	1.000	0.238	1.41
13. BREAD	0.332	0.468	0.021	0.822	0.270	1.091	0.217	0.112	1.000	0.281	1.07
14. OTHER BAKERY	0.911	1.250	0.062	2.223	0.833	3.057	0.624	0.304	1.000	0.731	3.33
15. CARBONATED BEVERAGES	1.014	1.224	0.034	2.273	1.172	3.446	0.333	0.318	1.000	0.561	2.34
16. DESSICATED COCONUT & COPRA	2.116	3.331	0.216	5.663	2.597	8.262	0.826	0.757	1.000	1.447	10.34
17. OTHER PROCESSED FOOD	0.841	1.300	0.066	2.207	1.012	3.219	2.092	0.298	1.000	0.790	4.12
18. DISTILLING	1.943	2.128	0.068	4.139	2.475	6.615	0.661	0.585	1.000	1.128	6.36
19. TOBACCO PRODUCTS	2.055	3.151	0.083	5.289	2.301	7.591	5.742	0.724	1.000	2.043	6.57
20. TEXTILES	0.520	1.105	0.026	1.651	0.260	1.910	0.433	0.219	1.000	0.985	1.985
21. WOOD PRODUCTS	1.768	4.158	0.073	5.999	0.600	6.598	0.703	0.792	1.000	2.705	8.032
22. PAPER	1.309	1.663	0.040	3.013	1.039	4.052	0.801	0.421	1.000	0.900	3.713
23. LEATHER &'c	1.688	2.068	0.071	3.826	1.290	5.116	0.821	0.534	1.000	1.024	6.236
24. RUBBER &'c	2.000	2.240	0.172	4.413	1.562	5.975	0.857	0.609	1.000	1.626	6.085
25. CHEMICALS	1.143	1.242	0.041	2.426	1.178	3.604	0.847	0.343	1.000	0.671	3.324
26. OILS & FATS	2.139	3.226	0.197	5.562	2.530	8.094	0.826	0.749	1.000	1.416	15.111
27. COCONUT FIBRE & YARN	1.385	4.203	0.359	5.947	1.173	7.121	0.633	0.735	1.000	1.336	6.943
28. PETROLEUM PRODUCTS	2.805	2.889	0.090	5.785	6.557	12.343	0.842	0.823	1.000	1.386	22.693
29. STRUCTURAL CLAY PRODUCTS	2.053	4.169	0.079	6.302	1.466	7.769	0.739	0.843	1.000	2.403	7.260
30. CERAMICS	1.028	2.596	0.043	3.666	0.726	4.393	0.718	0.481	1.000	1.649	4.413
31. CEMENT	1.082	1.595	0.040	2.717	2.606	5.323	1.065	0.374	1.000	0.858	6.022
32. BASIC METALS	0.544	0.692	0.028	1.264	0.390	1.654	0.683	0.175	1.000	0.439	1.881
33. LIGHT ENGINEERING	0.933	1.043	0.033	2.010	1.113	3.124	0.733	0.263	1.000	0.468	2.972
34. TRANSPORT EQUIPMENT	0.735	0.833	0.022	1.590	0.298	1.888	0.743	0.224	1.000	0.560	2.451
35. MACHINERY	0.835	0.771	0.024	1.630	0.774	2.404	0.683	0.234	1.000	0.415	2.346
36. OTHER MANUFACTURING	1.285	2.202	0.052	3.539	0.741	4.281	0.567	0.480	1.000	1.320	4.539
37. CONSTRUCTION	1.882	2.555	0.076	4.512	2.150	6.664	0.856	0.624	1.000	1.308	6.519
38. ELECTRICITY	2.226	2.837	0.087	5.150	2.931	8.082	0.791	0.717	1.000	1.571	5.766
39. ROAD PASSENGER TRANSPORT	1.951	2.533	0.078	4.562	1.281	5.844	0.813	0.634	1.000	1.289	5.721
40. RAIL TRANSPORT	1.572	2.308	0.062	3.942	0.914	4.857	0.391	0.542	1.000	1.231	4.777
41. WHOLESALE TRADE	2.927	3.213	0.094	6.235	3.247	9.484	1.275	0.882	1.000	1.422	6.317
42. RETAIL TRADE	2.389	3.891	0.123	6.404	1.386	7.790	0.944	0.869	1.000	2.381	6.243
43. OTHER TRANSPORT	2.216	2.835	0.087	5.138	1.920	7.060	0.805	0.715	1.000	1.415	5.637
44. COMMUNICATIONS	1.902	3.253	0.070	5.225	1.234	6.461	0.641	0.709	1.000	1.652	5.597
45. HOTELS &'c	1.780	3.131	0.097	5.007	1.341	6.349	0.724	0.674	1.000	1.965	7.893
46. PROFESSIONAL SERVICES	2.322	2.941	0.113	5.376	1.572	6.950	0.785	0.746	1.000	1.415	5.724
47. DWELLINGS	2.058	3.956	0.254	6.268	1.294	7.562	0.795	0.821	1.000	1.094	6.333
48. OTHER SERVICES											

TABLE 10 : RANKING OF SECTORS BY SIZE OF EFFECTS (DIRECT plus INDIRECT) on VARIOUS OBJECTIVES

	URBAN INCOME	RURAL INCOME	ESTATE INCOME	TOTAL HOUSEHOLD INCOME	OTHER INCOMES	VALUE-ADDED	GOVERNMENT REVENUE	IMPORTS	EMPLOYMENT	GROSS OUTPUT
1. TEA	46.000	36.000	1.000	12.000	37.000	29.000	22.000	20.000	1.000	27.000
2. RUBBER	39.000	13.000	2.000	13.000	23.000	15.000	35.000	30.000	5.000	39.000
3. COCONUT	25.000	20.000	5.000	24.000	6.000	9.000	33.000	38.000	34.000	45.000
4. PADDY	48.000	1.000	48.000	1.000	48.000	8.000	42.000	34.000	2.000	41.000
5. LIVESTOCK	27.000	16.000	9.000	20.000	12.000	17.000	24.000	36.000	47.000	24.000
6. FISH	1.000	17.000	34.000	10.000	19.000	4.000	45.000	41.000	18.000	44.000
7. LOGGING AND FIREWOOD	34.000	3.000	46.000	4.000	43.000	1.000	46.000	48.000	44.000	47.000
8. OTHER AGRIC	30.000	15.000	17.000	22.000	11.000	14.000	37.000	28.000	16.000	38.000
9. MINING	26.000	18.000	33.000	25.000	9.000	19.000	32.000	31.000	15.000	30.000
10. RICE MILLING	47.000	2.000	45.000	3.000	46.000	11.000	39.000	33.000	3.000	3.000
11. FLOUR MILLING	35.000	45.000	18.000	41.000	18.000	40.000	47.000	3.000	36.000	48.000
12. DAIRY PRODUCTS	45.000	41.000	15.000	47.000	35.000	47.000	15.000	2.000	42.000	18.000
13. BREAD	41.000	46.000	19.000	46.000	39.000	48.000	18.000	1.000	35.000	34.000
14. OTHER BAKERY	32.000	33.000	11.000	36.000	25.000	38.000	11.000	9.000	22.000	14.000
15. CARBONATED BEVERAGES	23.000	34.000	35.000	35.000	13.000	32.000	36.000	10.000	40.000	28.000
16. DESSICATED COCONUT & COP	22.000	24.000	7.000	26.000	7.000	12.000	29.000	37.000	31.000	4.000
17. OTHER PROCESSED FOOD	44.000	43.000	16.000	48.000	30.000	44.000	2.000	15.000	32.000	13.000
18. DISTILLING	11.000	35.000	27.000	33.000	4.000	24.000	30.000	23.000	30.000	9.000
19. TOBACCO PRODUCTS	42.000	33.000	33.000	44.000	23.000	43.000	1.000	40.000	27.000	37.000
20. TEXTILES	38.000	23.000	31.000	34.000	45.000	42.000	10.000	4.000	6.000	32.000
21. WOOD PRODUCTS	14.000	4.000	44.000	2.000	47.000	7.000	38.000	39.000	4.000	5.000
22. PAPER	19.000	30.000	40.000	32.000	24.000	35.000	9.000	13.000	25.000	25.000
23. LEATHER &'c	10.000	28.000	20.000	23.000	20.000	30.000	14.000	18.000	28.000	6.000
24. RUBBER &'c	6.000	31.000	6.000	23.000	17.000	28.000	16.000	22.000	13.000	11.000
25. CHEMICALS	24.000	39.000	29.000	37.000	16.000	36.000	6.000	12.000	38.000	12.000
26. OILS & FATS	21.000	25.000	8.000	27.000	8.000	13.000	27.000	35.000	33.000	1.000
27. COCONUT FIBRE & YARN	43.000	5.000	3.000	5.000	36.000	3.000	44.000	44.000	37.000	21.000
28. PETROLEUM PRODUCTS	31.000	47.000	37.000	40.000	1.000	5.000	40.000	42.000	45.000	2.000
29. STRUCTURAL CLAY PRODUCTS	16.000	6.000	42.000	7.000	29.000	2.000	43.000	45.000	9.000	22.000
30. CERAMICS	37.000	8.000	47.000	17.000	41.000	33.000	13.000	16.000	7.000	23.000
31. CEMENT	40.000	40.000	41.000	45.000	2.000	34.000	8.000	19.000	39.000	8.000
32. BASIC METALS	36.000	44.000	24.000	43.000	40.000	46.000	4.000	5.000	29.000	29.000
33. LIGHT ENGINEERING	33.000	42.000	32.000	39.000	15.000	39.000	7.000	11.000	46.000	20.000
34. TRANSPORT EQUIPMENT	29.000	37.000	43.000	33.000	42.000	45.000	3.000	6.000	21.000	15.000
35. MACHINERY	28.000	48.000	39.000	42.000	22.000	41.000	5.000	7.000	43.000	33.000
36. OTHER MANUFACTURING	17.000	12.000	28.000	16.000	38.000	31.000	21.000	14.000	12.000	16.000
37. CONSTRUCTION	20.000	27.000	26.000	30.000	10.000	26.000	20.000	24.000	26.000	10.000
38. ELECTRICITY	18.000	29.000	25.000	31.000	3.000	18.000	31.000	32.000	20.000	36.000
39. ROAD PASSENGER TRANSPORT	4.000	22.000	21.000	13.000	26.000	27.000	19.000	21.000	19.000	17.000
40. RAIL TRANSPORT	3.000	14.000	23.000	11.000	32.000	25.000	48.000	17.000	17.000	19.000
41. WHOLESALE TRADE	8.000	32.000	30.000	29.000	5.000	21.000	17.000	43.000	41.000	43.000
42. RETAIL TRADE	5.000	10.000	13.000	8.000	33.000	10.000	23.000	46.000	10.000	46.000
43. OTHER TRANSPORT	7.000	26.000	22.000	19.000	14.000	22.000	25.000	27.000	24.000	35.000
44. COMMUNICATIONS	9.000	9.000	36.000	9.000	31.000	16.000	41.000	26.000	14.000	26.000
45. HOTELS &'c	15.000	11.000	14.000	14.000	27.000	23.000	26.000	25.000	11.000	7.000
46. PROFESSIONAL SERVICES	-2.000	19.000	12.000	15.000	21.000	20.000	28.000	29.000	23.000	31.000
47. DWELLINGS	12.000	7.000	4.000	6.000	34.000	6.000	34.000	47.000	48.000	42.000
48. OTHER SERVICES	13.000	21.000	10.000	21.000	44.000	37.000	12.000			

TABLE 11 : RANKING OF SECTORS BY SIZE OF EFFECTS (DIRECT plus INDIRECT plus INDUCED) ON VARIOUS OBJECTIVES

	URBAN INCOME	RURAL INCOME	ESTATE INCOME	TOTAL HOUSEHOLD INCOME	OTHER INCOMES	VALUE-ADDED	GOVERNMENT REVENUE	SAVINGS	IMPORTS	EMPLOYMENT	GROSS OUTPUT
1. TEA	33.000	26.000	1.000	10.000	33.000	12.000	27.000	29.000	8.000	2.000	12.0
2. RUBBER	30.000	11.000	2.000	11.000	17.000	10.000	35.000	17.000	22.000	5.000	18.0
3. COCONUT	25.000	22.000	5.000	23.000	6.000	18.000	39.000	26.000	43.000	27.000	35.0
4. PADDY	37.000	1.000	15.000	1.000	42.000	1.000	19.000	2.000	11.000	1.000	6.0
5. LIVESTOCK	23.000	18.000	9.000	20.000	11.000	16.000	33.000	20.000	40.000	35.000	24.0
6. FISH	1.000	15.000	26.000	13.000	15.000	11.000	34.000	10.000	34.000	15.000	26.0
7. LOGGING AND FIREWOOD	12.000	4.000	20.000	4.000	35.000	4.000	24.000	3.000	21.000	20.000	9.0
8. OTHER AGRIC	28.000	16.000	18.000	21.000	10.000	17.000	40.000	21.000	36.000	17.000	29.0
9. MINING	26.000	19.000	32.000	24.000	9.000	22.000	38.000	23.000	38.000	18.000	28.0
10. RICE MILLING	35.000	2.000	16.000	3.000	40.000	3.000	22.000	4.000	15.000	3.000	1.0
11. FLOUR MILLING	41.000	40.000	31.000	41.000	29.000	41.000	48.000	42.000	4.000	41.000	48.0
12. DAIRY PRODUCTS	48.000	45.000	30.000	47.000	43.000	47.000	43.000	47.000	2.000	48.000	43.0
13. BREAD	46.000	47.000	38.000	46.000	46.000	48.000	45.000	46.000	1.000	43.000	46.0
14. OTHER BAKERY	34.000	34.000	17.000	36.000	32.000	36.000	13.000	36.000	10.000	32.000	31.0
15. CARBONATED BEVERAGES	29.000	36.000	41.000	35.000	14.000	35.000	46.000	35.000	13.000	39.000	39.0
16. DESSICATED COCONUT & COPRA	21.000	23.000	7.000	26.000	7.000	19.000	37.000	27.000	44.000	29.000	5.0
17. OTHER PROCESSED FOOD	47.000	46.000	33.000	48.000	39.000	46.000	2.000	48.000	33.000	42.000	42.0
18. DISTILLING	19.000	35.000	36.000	33.000	3.000	31.000	42.000	33.000	39.000	34.000	25.0
19. TOBACCO PRODUCTS	45.000	41.000	47.000	44.000	38.000	44.000	1.000	44.000	48.000	37.000	47.0
20. TEXTILES	42.000	27.000	37.000	34.000	47.000	39.000	12.000	34.000	3.000	11.000	38.0
21. WOOD PRODUCTS	2.000	3.000	14.000	2.000	41.000	2.000	11.000	1.000	17.000	4.000	3.0
22. PAPER	24.000	32.000	39.000	32.000	31.000	34.000	8.000	32.000	19.000	31.000	33.0
23. LEATHER &'c	14.000	28.000	25.000	28.000	22.000	30.000	14.000	25.000	25.000	26.000	11.0
24. RUBBER &'c	11.000	29.000	6.000	25.000	16.000	27.000	17.000	22.000	29.000	16.000	19.0
25. CHEMICALS	32.000	37.000	42.000	37.000	23.000	37.000	6.000	37.000	20.000	38.000	34.0
26. OILS & FATS	18.000	25.000	8.000	27.000	8.000	21.000	36.000	24.000	42.000	30.000	2.0
27. COCONUT FIBRE & YARN	27.000	5.000	3.000	5.000	27.000	5.000	31.000	7.000	23.000	19.000	8.0
28. PETROLEUM PRODUCTS	39.000	43.000	44.000	40.000	1.000	32.000	47.000	40.000	47.000	46.000	4.0
29. STRUCTURAL CLAY PRODUCTS	9.000	6.000	23.000	7.000	19.000	7.000	29.000	6.000	30.000	6.000	10.0
30. CERAMICS	31.000	10.000	35.000	17.000	37.000	25.000	9.000	16.000	16.000	8.000	20.0
31. CEMENT	44.000	42.000	48.000	45.000	4.000	38.000	18.000	45.000	41.000	44.000	32.0
32. BASIC METALS	43.000	44.000	40.000	43.000	45.000	45.000	4.000	43.000	5.000	40.000	45.0
33. LIGHT ENGINEERING	40.000	39.000	43.000	39.000	21.000	40.000	10.000	39.000	18.000	47.000	41.0
34. TRANSPORT EQUIPMENT	36.000	38.000	45.000	39.000	48.000	43.000	3.000	38.000	6.000	33.000	36.0
35. MACHINERY	38.000	48.000	46.000	42.000	34.000	42.000	5.000	41.000	9.000	45.000	44.0
36. OTHER MANUFACTURING	15.000	14.000	27.000	16.000	36.000	24.000	21.000	14.000	12.000	12.000	15.0
37. CONSTRUCTION	22.000	30.000	28.000	29.000	12.000	29.000	28.000	30.000	37.000	25.000	23.0
38. ELECTRICITY	20.000	31.000	29.000	31.000	2.000	26.000	41.000	31.000	45.000	24.000	37.0
39. ROAD PASSENGER TRANSPORT	8.000	20.000	21.000	18.000	25.000	23.000	16.000	15.000	26.000	21.000	17.0
40. RAIL TRANSPORT	5.000	13.000	19.000	12.000	30.000	13.000	44.000	11.000	14.000	14.000	13.0
41. WHOLESALE TRADE	16.000	33.000	34.000	30.000	5.000	28.000	23.000	28.000	46.000	36.000	40.0
42. RETAIL TRADE	3.000	8.000	10.000	8.000	28.000	8.000	15.000	8.000	32.000	7.000	21.0
43. OTHER TRANSPORT	10.000	24.000	24.000	19.000	13.000	20.000	30.000	18.000	35.000	23.000	27.0
44. COMMUNICATIONS	6.000	9.000	22.000	9.000	24.000	9.000	32.000	9.000	24.000	13.000	14.0
45. HOTELS &'c	13.000	12.000	13.000	14.000	20.000	14.000	25.000	13.000	27.000	9.000	7.0
46. PROFESSIONAL SERVICES	4.000	17.000	12.000	15.000	18.000	15.000	26.000	12.000	31.000	22.000	22.0
47. DWELLINGS	7.000	7.000	4.000	6.000	26.000	6.000	20.000	5.000	23.000	28.000	16.0

TABLE 12 : RANKING OF EFFECTS (DIRECT plus INDIRECT plus INDUCED PER UNIT OF IMPORTS

		URBAN INCOME	RURAL INCOME	ESTATE INCOME	TOTAL HOUSEHOLD INCOME	OTHER INCOMES	VALUE-ADDED	GOVERNMENT REVENUE	SAVINGS	IMPORTS	EMPLOYMENT	GROSS OUTPUT
1.	TEA	39.000	33.000	1.000	30.000	35.000	32.000	42.000	36.000	1.000	5.000	32.000
2.	RUBBER	30.000	20.000	2.000	24.000	20.000	24.000	38.000	28.000	2.000	3.000	30.000
3.	COCONUT	13.000	11.000	5.000	11.000	6.000	4.000	18.000	10.000	3.000	18.000	28.000
4.	PADDY	40.000	1.000	32.000	14.000	42.000	26.000	41.000	20.000	4.000	1.000	24.000
5.	LIVESTOCK	16.000	9.000	8.000	12.000	11.000	8.000	10.000	13.000	5.000	31.000	9.000
6.	FISH	3.000	10.000	18.000	6.000	15.000	7.000	21.000	3.000	6.000	10.000	20.000
7.	LOGGING AND FIREWOOD	25.000	2.000	23.000	4.000	32.000	15.000	31.000	7.000	7.000	28.000	17.000
8.	OTHER AGRIC	23.000	14.000	12.000	22.000	13.000	14.000	33.000	22.000	8.000	12.000	29.000
9.	MINING	20.000	15.000	24.000	19.000	10.000	13.000	25.000	19.000	9.000	11.000	21.000
10.	RICE MILLING	36.000	3.000	31.000	15.000	40.000	25.000	39.000	21.000	10.000	2.000	4.000
11.	FLOUR MILLING	44.000	46.000	42.000	46.000	39.000	45.000	48.000	46.000	11.000	46.000	47.000
12.	DAIRY PRODUCTS	48.000	47.000	44.000	47.000	45.000	47.000	46.000	47.000	12.000	48.000	46.000
13.	BREAD	47.000	48.000	48.000	48.000	47.000	48.000	47.000	48.000	13.000	47.000	48.000
14.	OTHER BAKERY	38.000	38.000	33.000	39.000	34.000	41.000	36.000	39.000	14.000	39.000	38.000
15.	CARBONATED BEVERAGES	35.000	40.000	40.000	33.000	28.000	37.000	45.000	38.000	15.000	41.000	41.000
16.	DESSICATED COCONUT & COPRA	9.000	12.000	6.000	10.000	5.000	3.000	12.000	9.000	16.000	17.000	3.000
17.	OTHER PROCESSED FOOD	41.000	37.000	30.000	40.000	31.000	38.000	2.000	40.000	17.000	38.000	35.000
18.	DISTILLING	17.000	31.000	29.000	28.000	8.000	20.000	32.000	27.000	18.000	32.000	12.000
19.	TOBACCO PRODUCTS	11.000	18.000	19.000	17.000	9.000	11.000	1.000	15.000	19.000	8.000	10.000
20.	TEXTILES	46.000	41.000	45.000	42.000	48.000	43.000	43.000	44.000	20.000	35.000	44.000
21.	WOOD PRODUCTS	22.000	6.000	25.000	7.000	41.000	21.000	28.000	8.000	21.000	4.000	5.000
22.	PAPER	28.000	34.000	38.000	34.000	30.000	35.000	16.000	33.000	22.000	36.000	37.000
23.	LEATHER &'c	24.000	32.000	26.000	31.000	23.000	30.000	13.000	30.000	23.000	34.000	16.000
24.	RUBBER &'c	14.000	29.000	9.000	27.000	17.000	27.000	6.000	26.000	24.000	15.000	18.000
25.	CHEMICALS	31.000	39.000	37.000	37.000	26.000	36.000	8.000	37.000	25.000	40.000	36.000
26.	OILS & FATS	8.000	16.000	7.000	13.000	7.000	5.000	11.000	11.000	26.000	20.000	2.000
27.	COCONUT FIBRE & YARN	27.000	4.000	3.000	8.000	27.000	16.000	35.000	14.000	27.000	24.000	8.000
28.	PETROLEUM PRODUCTS	2.000	22.000	15.000	9.000	1.000	1.000	9.000	5.000	28.000	23.000	1.000
29.	STRUCTURAL CLAY PRODUCTS	12.000	5.000	20.000	2.000	18.000	10.000	23.000	4.000	29.000	6.000	7.000
30.	CERAMICS	34.000	25.000	36.000	32.000	38.000	33.000	27.000	31.000	30.000	14.000	34.000
31.	CEMENT	32.000	35.000	39.000	36.000	4.000	29.000	4.000	34.000	31.000	37.000	19.000
32.	BASIC METALS	45.000	45.000	43.000	45.000	44.000	46.000	30.000	45.000	32.000	44.000	45.000
33.	LIGHT ENGINEERING	37.000	42.000	41.000	41.000	29.000	40.000	24.000	41.000	33.000	43.000	39.000
34.	TRANSPORT EQUIPMENT	43.000	43.000	47.000	44.000	46.000	44.000	22.000	43.000	34.000	42.000	42.000
35.	MACHINERY	42.000	44.000	46.000	43.000	36.000	42.000	29.000	42.000	35.000	45.000	43.000
36.	OTHER MANUFACTURING	29.000	30.000	35.000	33.000	37.000	34.000	40.000	32.000	36.000	25.000	33.000
37.	CONSTRUCTION	19.000	26.000	22.000	26.000	12.000	19.000	7.000	25.000	37.000	26.000	11.000
38.	ELECTRICITY	6.000	23.000	16.000	20.000	3.000	6.000	19.000	16.000	38.000	16.000	25.000
39.	ROAD PASSENGER TRANSPORT	15.000	27.000	21.000	25.000	24.000	28.000	14.000	24.000	39.000	27.000	26.000
40.	RAIL TRANSPORT	26.000	28.000	34.000	29.000	33.000	31.000	44.000	29.000	40.000	30.000	31.000
41.	WHOLESALE TRADE	1.000	17.000	14.000	5.000	2.000	2.000	3.000	1.000	41.000	19.000	14.000
42.	RETAIL TRADE	4.000	8.000	10.000	1.000	19.000	9.000	5.000	2.000	42.000	7.000	15.000
43.	OTHER TRANSPORT	7.000	24.000	17.000	21.000	14.000	17.000	15.000	17.000	43.000	21.000	27.000
44.	COMMUNICATIONS	18.000	13.000	27.000	18.000	25.000	22.000	34.000	18.000	44.000	13.000	23.000
45.	HOTELS &'c	21.000	19.000	13.000	23.000	21.000	23.000	26.000	23.000	45.000	9.000	6.000
46.	PROFESSIONAL SERVICES	5.000	21.000	11.000	16.000	16.000	18.000	20.000	12.000	46.000	22.000	22.000
47.	DWELLINGS	10.000	7.000	4.000	3.000	22.000	12.000	17.000	6.000	47.000	33.000	13.000
48.	OTHER SERVICES	33.000	36.000	28.000	35.000	43.000	39.000	37.000	35.000	48.000	29.000	40.000

tea varies from 5th when employment creation is considered to 39th when urban household income is the objective.

Looking in detail at Table 12, col.6, we see that, from the point of view of value added, the first five 'key' sectors are Petroleum and Coal Products,[1] Wholesale Trade, Dessicated Coconut and Copra, Coconut, and Oils and Fats.

From the employment point of view the highest ranking sectors are Paddy, Rice-Milling, Rubber, Wood Products and Tea - a completely different set of sectors. General 'conflicts of objectives' are clearly illustrated by the rankings. As discussed in Roe and Tyler {1977a, p.17} these conflicts can be summarised by calculating coefficients of rank correlation between objectives and Table 13 gives a full matrix of rank correlation-coefficients between 10 objectives, as derived from the semi-aggregated 12 activity data system, while Table 14 presents the same matrix as derived from the results of the full 48 activity model. These results must be treated with some care, however, especially those based on the 'sample' of only 12 activities, since coefficients may not be significant, in the statistical sense.[2]

1/ Petroleum and Coal Products ranks unusually high because in 1970 imports of petroleum were extremely low, while stocks were run down, and no adjustment has been made for this.

2/ If there is no real correlation between two sets of rankings then the expected distribution of estimates of the rank correlation coefficients r' based on samples of size n taken from the rankings is approximated by the normal distribution having mean 0 and the standard deviation

Table 13.

Matrix of rank correlation coefficients, for activities ranked by various objectives achieved per unit of imports — The 12 activity Semi-aggregated Model

OBJECTIVE BY WHICH ACTIVITIES ARE RANKED

OBJECTIVE CORRELATED WITH	Urban Income	Rural Income	Estate Income	Total Household Income	Other Inst. Income	Value Added	Govnt. Revenue	Savings	Employ-ment	Gross Output
Urban Income	1.00	0.37	0.18	0.55	0.83	0.69	0.59	0.51	-0.45	0.71
Rural Income		1.00	0.13	0.92	0.27	0.66	-0.21	0.55	0.40	0.57
Estate Income			1.00	0.32	0.40	0.54	-0.40	-0.10	0.29	0.15
Total Household Income				1.00	0.42	0.80	-0.09	0.57	0.30	0.59
Other Institutions Income					1.00	0.65	0.37	0.22	-0.38	0.73
Value Added						1.00	0.02	0.40	0.25	0.70
Government Revenue							1.00	0.51	-0.73	0.31
Savings								1.00	-0.06	0.50
Employment									1.00	-0.06
Gross Output										1.00

(Co-efficients outside the range $\pm$ 0.59 are significant at the 95% confidence level)

Table 14.

Matrix of rank correlation coefficients, of activities ranked by various objectives achieved per unit of imports. — The 48 activity disaggregated Model

OBJECTIVE BY WHICH ACTIVITIES ARE RANKED

OBJECTIVE CORRELATED WITH	Urban Income	Rural Income	Estate Income	Total Household Income	Other Inst. Income	Value Added	Govnt. Revenue	Savings	Employ-ment	Gross Output
Urban Income	1.00	0.62	0.72	0.80	0.83	0.90	0.62	0.88	0.51	0.80
Rural Income		1.00	0.68	0.94	0.41	0.81	0.22	0.89	0.78	0.72
Estate Income			1.00	0.76	0.64	0.79	0.38	0.74	0.64	0.68
Total Household Income				1.00	0.57	0.91	0.36	0.98	0.71	0.79
Other Institutions Income					1.00	0.82	0.67	0.65	0.34	0.80
Value Added						1.00	0.52	0.94	0.63	0.89
Government Revenue							1.00	0.46	0.12	0.59
Savings								1.00	0.67	0.82
Employment									1.00	0.61
Gross Output										1.00

(Co-efficients outside the range $\pm$ 0.29 are significant at the 95% confidence level)

We can see from Table 13, that in the small sample case, many
of the coefficients are not statistically significant. In general the
nature of relationships between objectives are confirmed by the 48
activity model, but the contrasts are less marked.

Thus the strategy concentrating on gross output would
favour urban incomes to rural incomes (see last column of Table 13) and
all incomes to employment; there is not, however, in the 48 activity
model an inverse correlation between employment and gross output.

A strategy based on value added (ie. net output) would
similarly favour urban incomes against rural, and all incomes against
employment.

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footnote 2/. continued

$1 / \sqrt{n-1}$; providing the sample size is large. Thus if we
wish to test the hypothesis that the rank correlation coefficient
we estimate is not the random result of two unrelated sets of
rankings, with 95% confidence, then the coefficient must be
outside the range:

$$\frac{-1.96}{n-1} > r' < \frac{1.96}{n-1}$$

For a 12 sample case, therefore, the estimate of the rank
correlation coefficient must be less than -.59 or more than +.59
to be statistically significant at the 95% confidence level,
while in the 48 sample size case, the coefficient must lie
outside the range $\pm$ .29

An employment based strategy (see col.9 of Table 13) would favour rural incomes compared to estate incomes, and estate incomes compared to urban incomes. It would be strongly counter to the aim of raising government revenue.

Other institutions' incomes (i.e. profits) are related most closely to urban incomes and have a very low correlation with employment (see col.5).

In the semi-aggregated case, government revenue has a negative correlation with rural and estate incomes, and with employment. In the full 48 activity model, the correlations are positive but very weak.

Thus our analysis does appear to illustrate the 'dual economy' picture of Sri Lanka in which a high income, high profit, high government revenue urban sector contrasts with a high employment low productivity rural sector. Since highly labour intensive sectors usually provide incomes for the poor, the classic choice presents itself of a rural based strategy, to achieve high employment and reduce poverty, and an urban based strategy to generate high output and high re-investable profits and government revenues.

Our disaggregated analysis does indicate a degree of flexibility in policy choice because it does identify a number of labour intensive, but predominantly urban, activities (fishing, dessicated coconut and copra, structural clay products, trade) and sectors that are both 'profitable' and labour intensive (Coconut, fishing, other agriculture, mining, tobacco products).

Finally we look again at the 'distance' between sectors as
an indication of the value of disaggregated analysis.   The results for
the 48 activity analysis presented in Table 4 confirm the overall picture
presented in Table 5 of Roe and Tyler {1977a}.   Namely, that when a
greater degree of endogeneity is introduced into the model, the results
indicate smaller contrasts between the impact of activities on various
objectives than was formerly present.   Taking the value-added objective, while
there is an average of 16.2% difference between direct-coefficients
in the rank order, there is only a 2½% difference when total indirect
repercussions are allowed for - although of course, this represents a
wide total spread over 48 sectors ,220% in fact.   In the import constrained
case, the average distance is 5.6% in terms of both value added and
employment.   The rankings as presented are probably quite sensitive to
data errors and changes in economic structure over time, but the conclusion
that there exists a great deal of overall variation amongst activities in
their potential impact on the various objectives remains.   Thus the
complexities of analysis and planning cannot be evaded.

6.   Semi Input-Output Model

Roe and Tyler {1977a} also consider some models incorporating
a capital/accelerator relationship, under conditions of capacity constraints.
Here we present corresponding, disaggregated results for the Semi Input-
Output model, examined in pp.23-35 of the earlier paper.

The model   splits the 48 activities into tradeable (internationally)

and non-tradeable sectors,

and assumes expansion of tradeable sectors requires direct investment in these sectors, and induces investment in non-tradeable sectors.

Sectors 1 to 36 of our 48 activities (Tea to Manufactures n.e.s.) are assumed tradeable, and sectors 37 to 48 (Construction to Other Services) are assumed non-tradeable. Table 15 presents the disaggregated capital-output matrix for the 48 activities i.e. the total capital required and its distribution in terms of supplying activities (but including imported requirements). The conceptual and practical problems in devising capital/output ratios should be recalled in the use of this Table.

Table 16 gives the comprehensive effects on various objectives of expanding the output of tradeable sectors by one unit, under Semi Input/Output assumptions. Table 17 normalises these effects w.r.t. imports, while Tables 18 and 19 present the rankings of the 36 sectors for the various objectives and for the normalised and non-normalized cases.

Because of the wide variation in capital output ratios, we observe substantial changes in rank order, when we compare the 'comprehensive' effects of Table 19 with those of Table 11. With its capital output ratio of 5.20, involving substantial demands on the Construction sector, 'Rubber' becomes the largest generator of income and employment, while Paddy, with its low capital requirements generates

Table 15. 30.

Capital Matrix - 1970

Activities	Capital Goods Supplying Sectors					Total Capital Output Ratio
	33 Light Engineering	34 Transport Equipment	35 Machinery etc.	37 Construction	41 Wholesale Trade	
1	–	0.10	0.39	0.47	0.06	1.02
2	0.71	0.33	0.96	2.92	0.28	5.20
3	–	–	–	1.00	0.06	1.05
4	0.03	0.01	0.09	0.06	0.03	0.22
5	0.09	–	–	0.52	0.01	0.62
6	–	0.59	–	0.62	0.15	1.36
7	0.01	0.10	0.25	0.93	0.09	1.38
8	0.02	–	0.01	0.09	–	0.12
9	0.17	0.05	0.27	1.47	–	1.96
10	–	0.06	0.29	0.36	0.08	0.79
11	–	0.06	0.29	0.36	–	0.79
12	0.06	0.01	0.22	0.37	–	0.66
13	0.05	0.06	0.32	0.23	–	0.66
14	0.05	0.06	0.35	0.26	–	0.72
15	0.01	0.01	0.24	0.10	0.03	0.36
16	–	–	0.13	0.12	0.09	0.28
17	–	0.02	0.36	0.38	–	0.85
18	0.01	0.01	0.14	0.06	–	0.22
19	0.01	0.02	0.17	0.10	–	0.30
20	0.06	0.05	1.42	0.77	–	2.30
21	0.07	0.03	1.22	0.80	–	2.12
22	0.13	0.06	1.41	1.03	–	2.62
23	0.10	0.01	0.43	0.24	–	0.78
24	0.15	0.19	0.15	1.43	–	1.92
25	0.16	0.04	1.20	1.23	–	2.63
26	0.06	0.12	0.87	0.27	–	1.32
27	0.12	–	0.11	0.20	–	0.43
28	–	–	3.00	0.92	–	3.92
29	0.12	0.05	0.29	1.59	–	2.05
30	0.01	0.02	0.61	0.64	0.16	1.44
31	0.01	0.02	1.45	0.74	–	2.22
32	0.01	0.02	0.81	0.77	0.22	1.83
33	0.04	0.01	0.38	0.13	–	0.56
34	0.01	–	0.70	0.62	0.06	1.41
35	0.03	–	0.49	0.43	0.19	1.14
36	–	–	–	–	–	2.00
37	0.02	0.02	0.36	0.05	0.09	0.54
38	2.10	–	0.82	3.59	0.44	6.95
39	0.98	2.47	0.15	–	0.16	3.76
40	0.39	1.10	–	2.55	0.32	4.36
41	0.02	0.06	–	0.64	–	0.72
42	0.02	0.06	–	0.64	–	0.72
43	0.02	0.06	–	0.64	–	0.72
44	0.86	0.19	3.48	0.13	–	4.66
45	0.02	0.06	–	0.64	–	0.72
46	0.02	0.06	–	0.64	–	0.72
47	0.86	0.19	3.48	0.13	–	4.66
48	0.86	0.19	3.48	0.13	–	4.66

TABLE 16 : SEMI-INPUT OUTPUT EFFECTS OF SECTORAL EXPANSION ON VARIOUS OBJECTIVES

	URBAN INCOME	RURAL INCOME	ESTATE INCOME	TOTAL HOUSEHOLD INCOME	OTHER INCOMES	VALUE-ADDED	GOVERNMENT REVENUE	SAVINGS	IMPORTS	EMPLOYMENT	GROSS OUTPUT
1. TEA	0.456	0.501	0.480	1.437	0.511	1.948	0.189	0.144	1.378	0.870	1.63
2. RUBBER	1.588	1.757	0.232	3.579	1.950	5.529	0.562	0.483	3.394	1.062	2.72
3. COCONUT	0.764	0.841	0.049	1.655	0.983	2.644	0.252	0.231	1.399	0.306	1.73
4. PADDY	0.212	1.194	0.008	1.415	0.131	1.547	0.104	0.176	1.058	0.744	1.48
5. LIVESTOCK	0.515	0.650	0.032	1.197	0.637	1.835	0.167	0.165	1.046	0.160	1.49
6. FISHING	0.455	0.831	0.018	1.705	0.771	2.475	0.245	0.245	1.294	0.389	1.70
7. LOGGING &'c	0.791	1.354	0.020	2.164	0.737	2.872	0.255	0.295	1.691	0.294	1.87
8. OTHER AGRICULTURE	0.322	0.498	0.013	0.833	0.425	1.258	0.088	0.114	0.691	0.253	1.29
9. MINING &'c	0.963	1.051	0.025	2.039	1.221	3.261	0.322	0.289	1.915	0.498	2.32
10. RICE-MILLING	0.249	0.226	0.007	0.482	0.300	0.782	0.088	0.069	1.385	0.191	1.28
11. FLOUR-MILLING	0.449	0.393	0.017	0.859	0.545	1.404	0.122	0.124	1.079	0.125	1.38
12. DAIRY PRODUCTS	0.255	0.252	0.010	0.517	0.279	0.796	0.147	0.074	1.235	0.150	1.29
13. BREAD	0.274	0.276	0.018	0.563	0.271	0.833	0.144	0.080	1.039	0.205	1.33
14. OTHER BAKERY PRODUCTS	0.393	0.389	0.018	0.800	0.404	1.294	0.220	0.113	0.992	0.166	1.46
15. CARBONATED BEVERAGES	0.474	0.435	0.011	0.920	0.420	1.500	0.113	0.133	0.986	0.054	1.51
16. DESSICATED COCONUT COPRA	0.152	0.136	0.004	0.291	0.579	0.469	0.127	0.042	1.130	0.166	1.26
17. OTHER PROCESSED FOODS	0.311	0.314	0.012	0.637	0.177	1.037	0.053	0.091	0.890	0.198	1.34
18. DISTILLING &'c	0.282	0.228	0.005	0.516	0.400	0.892	0.511	0.075	0.709	0.140	1.22
19. TOBACCO PRODUCTS	0.198	0.221	0.005	0.423	0.376	0.658	0.074	0.060	0.408	0.505	1.20
20. TEXTILES	0.536	0.686	0.016	1.237	0.235	1.738	0.569	0.173	1.504	0.595	1.62
21. WOOD PRODUCTS	0.675	0.984	0.015	1.675	0.501	2.187	0.288	0.232	1.706	0.304	1.37
22. PAPER &'c	0.750	0.692	0.017	1.460	0.511	2.246	0.218	0.211	1.543	0.159	1.74
23. LEATHER &'c	0.405	0.351	0.008	0.765	0.785	1.120	0.336	0.111	1.070	0.400	1.43
24. RUBBER &'c	0.972	0.803	0.022	1.796	0.354	2.811	0.165	0.262	1.934	0.275	1.75
25. CHEMICALS	0.750	0.642	0.017	1.411	1.014	2.303	0.345	0.205	1.653	0.069	1.77
26. OILS & FATS	0.195	0.175	0.095	0.374	0.892	0.599	0.369	0.054	1.240	0.169	1.27
27. COCONUT FIBRE & YARN	0.307	0.839	0.084	1.230	0.225	1.493	0.066	0.152	1.063	0.175	1.46
28. PETROLEUM PRODUCTS	0.497	0.438	0.013	0.948	0.262	1.697	0.104	0.137	1.556	0.623	1.54
29. STRUCTURAL CLAY PRODUCTS	1.026	1.254	0.025	2.306	0.743	3.361	0.163	0.324	2.098	0.540	2.14
30. CERAMICS	0.675	0.990	0.016	1.681	1.055	2.350	0.326	0.232	1.601	0.181	1.31
31. CEMENT &'c	0.460	0.437	0.012	0.909	0.664	1.701	0.329	0.131	1.339	0.277	1.55
32. BASIC METALS	0.634	0.583	0.020	1.237	0.791	1.899	0.258	0.178	1.529	0.093	1.60
33. LIGHT ENGINEERING	0.318	0.268	0.003	0.593	0.662	1.003	0.421	0.199	0.769	0.221	1.36
34. TRANSPORT EQUIPMENT	0.549	0.438	0.011	0.999	0.409	1.473	0.199	0.086	1.354	0.191	1.59
35. MACHINERY &'c	0.534	0.453	0.013	1.050	0.474	1.691	0.382	0.146	1.168		1.56
36. OTHER MANUFACTURING	0.353	0.502	0.009	0.864	0.183	1.052	0.115	0.154			1.564

TABLE 17 : SEMI INPUT-OUTPUT EFFECTS (DIRECT plus INDIRECT plus INDUCED) per unit of IMPORTS

	URBAN INCOME	RURAL INCOME	ESTATE INCOME	TOTAL HOUSEHOLD INCOME	OTHER INCOMES	VALUE-ADDED	GOVERNMENT REVENUE	SAVINGS	IMPORTS	EMPLOYMENT	GROSS OUTPUT
1. TEA	0.331	0.363	0.348	1.043	0.370	1.413	0.137	0.104	1.000	0.631	1.189
2. RUBBER	0.468	0.518	0.069	1.054	0.575	1.629	0.165	0.142	1.000	0.313	0.802
3. COCONUT	0.546	0.601	0.035	1.183	0.706	1.889	0.180	0.165	1.000	0.219	1.241
4. PADDY	0.201	1.129	0.008	1.338	0.124	1.462	0.098	0.167	1.000	0.703	1.401
5. LIVESTOCK	0.493	0.621	0.031	1.144	0.609	1.754	0.159	0.158	1.000	0.153	1.427
6. FISHING	0.661	0.643	0.014	1.318	0.596	1.913	0.177	0.189	1.000	0.300	1.314
7. LOGGING &'c	0.468	0.800	0.012	1.280	0.418	1.698	0.151	0.174	1.000	0.174	1.111
8. OTHER AGRICULTURE	0.466	0.721	0.019	1.206	0.615	1.822	0.128	0.165	1.000	0.366	1.870
9. MINING &'c	0.503	0.549	0.013	1.065	0.638	1.703	0.168	0.151	1.000	0.260	1.357
10. RICE-MILLING	0.180	0.163	0.005	0.348	0.216	0.565	0.064	0.050	1.000	0.066	0.326
11. FLOUR-MILLING	0.416	0.364	0.016	0.795	0.505	1.301	0.113	0.114	1.000	0.177	1.284
12. DAIRY PRODUCTS	0.207	0.204	0.008	0.419	0.226	0.644	0.119	0.060	1.000	0.101	1.049
13. BREAD	0.264	0.266	0.012	0.541	0.260	0.802	0.139	0.077	1.000	0.144	1.284
14. OTHER BAKERY PRODUCTS	0.396	0.392	0.019	0.806	0.407	1.213	0.222	0.114	1.000	0.206	1.478
15. CARBONATED BEVERAGES	0.481	0.441	0.011	0.933	0.587	1.521	0.129	0.135	1.000	0.169	1.540
16. DESSICATED COCONUT COPR	0.134	0.120	0.004	0.258	0.157	0.415	0.047	0.037	1.000	0.048	1.115
17. OTHER PROCESSED FOODS	0.350	0.353	0.014	0.716	0.450	1.166	0.574	0.102	1.000	0.187	1.515
18. DISTILLING &'c	0.397	0.322	0.009	0.727	0.529	1.257	0.104	0.106	1.000	0.152	1.723
19. TOBACCO PRODUCTS	0.485	0.540	0.012	1.037	0.576	1.613	1.394	0.147	1.000	0.344	2.347
20. TEXTILES	0.356	0.456	0.010	0.823	0.333	1.156	0.192	0.115	1.000	0.336	1.383
21. WOOD PRODUCTS	0.396	0.577	0.010	0.982	0.300	1.282	0.128	0.136	1.000	0.349	1.399
22. PAPER &'c	0.486	0.449	0.011	0.946	0.509	1.455	0.218	0.136	1.000	0.197	1.130
23. LEATHER &'c	0.380	0.328	0.008	0.715	0.331	1.046	0.154	0.104	1.000	0.148	1.337
24. RUBBER &'c	0.502	0.415	0.011	0.929	0.525	1.454	0.179	0.135	1.000	0.207	1.012
25. CHEMICALS	0.454	0.388	0.011	0.854	0.540	1.393	0.223	0.124	1.000	0.167	1.071
26. OILS & FATS	0.157	0.141	0.004	0.302	0.181	0.483	0.053	0.044	1.000	0.056	1.030
27. COCONUT FIBRE & YARN	0.289	0.789	0.079	1.157	0.247	1.404	0.098	0.143	1.000	0.159	1.376
28. PETROLEUM PRODUCTS	0.319	0.282	0.008	0.609	0.481	1.090	0.105	0.088	1.000	0.112	0.791
29. STRUCTURAL CLAY PRODUCTS	0.489	0.598	0.012	1.099	0.503	1.602	0.156	0.154	1.000	0.297	1.321
30. CERAMINCS	0.422	0.618	0.010	1.050	0.418	1.468	0.206	0.145	1.000	0.338	1.131
31. CEMENT &'c	0.343	0.327	0.009	0.679	0.591	1.270	0.192	0.098	1.000	0.135	1.164
32. BASIC METALS	0.415	0.382	0.013	0.809	0.433	1.242	0.276	0.116	1.000	0.181	1.047
33. LIGHT ENGINEERING	0.413	0.349	0.010	0.772	0.532	1.304	0.259	0.112	1.000	0.121	1.781
34. TRANSPORT EQUIPMENT	0.406	0.324	0.008	0.738	0.350	1.088	0.282	0.108	1.000	0.164	1.179
35. MACHINERY &'c	0.501	0.388	0.011	0.900	0.549	1.449	0.283	0.132	1.000	0.164	1.340
36. OTHER MANUFACTURING	0.396	0.564	0.010	0.971	0.212	1.182	0.129	0.134	1.000	0.331	1.601

TABLE 18 RANKING OF SEMI INPUT-OUTPUT EFFECTS ON VARIOUS OBJECTIVES

	URBAN INCOME	RURAL INCOME	ESTATE INCOME	TOTAL HOUSEHOLD INCOME	OTHER INCOMES	VALUE-ADDED	GOVERNMENT REVENUE	SAVINGS	IMPORTS	EMPLOYMENT	GROSS OUTPUT
1. TEA	20.000	16.000	4.000	11.000	19.000	12.000	21.000	19.000	15.000	2.000	12.000
2. RUBBER	1.000	1.000	2.000	1.000	1.000	1.000	2.000	1.000	1.000	1.000	1.000
3. COCONUT	7.000	8.000	8.000	9.000	5.000	5.000	16.000	9.000	13.000	11.000	10.000
4. PADDY	33.000	4.000	29.000	12.000	36.000	19.000	31.000	13.000	26.000	3.000	21.000
5. LIVESTOCK	16.000	14.000	5.000	17.000	15.000	14.000	22.000	15.000	27.000	27.000	20.000
6. FISHING	5.000	10.000	13.000	6.000	9.000	7.000	17.000	6.000	18.000	10.000	11.000
7. LOGGING &'c	6.000	2.000	9.000	3.000	11.000	4.000	15.000	3.000	6.000	13.000	5.000
8. OTHER AGRICULTURE	25.000	19.000	19.000	25.000	22.000	7.000	22.000	6.000	18.000	10.000	20.000
9. MINING &'c	4.000	5.000	7.000	4.000	2.000	4.000	15.000	3.000	6.000	13.000	11.000
10. RICE-MILLING	32.000	33.000	32.000	33.000	28.000	33.000	32.000	25.000	35.000	17.000	31.000
11. FLOUR-MILLING	21.000	25.000	15.000	24.000	17.000	23.000	12.000	4.000	4.000	8.000	3.000
12. DAIRY PRODUCTS	31.000	31.000	27.000	30.000	29.000	33.000	33.000	33.000	14.000	34.000	32.000
13. BREAD	30.000	29.000	22.000	31.000	30.000	23.000	28.000	23.000	23.000	20.000	26.000
14. OTHER BAKERY PRODUCTS	23.000	26.000	12.000	26.000	24.000	32.000	25.000	32.000	20.000	31.000	30.000
15. CARBONATED BEVERAGES	18.000	24.000	26.000	21.000	16.000	31.000	26.000	30.000	28.000	29.000	29.000
16. DESSICCATED COCONUT COPRA	36.000	36.000	36.000	36.000	35.000	25.000	18.000	26.000	29.000	19.000	22.000
17. OTHER PROCESSED FOODS	27.000	28.000	24.000	28.000	25.000	20.000	27.000	21.000	30.000	25.000	19.000
18. DISTILLING &'c	29.000	32.000	33.000	32.000	36.000	36.000	36.000	36.000	22.000	36.000	34.000
19. TOBACCO PRODUCTS	34.000	34.000	35.000	34.000	26.000	30.000	3.000	28.000	32.000	26.000	28.000
20. TEXTILES	15.000	13.000	18.000	14.000	32.000	34.000	34.000	31.000	34.000	32.000	35.000
21. WOOD PRODUCTS	11.000	11.000	16.000	8.000	20.000	15.000	1.000	34.000	36.000	30.000	36.000
22. PAPER &'c	8.000	12.000	14.000	10.000	8.000	11.000	13.000	14.000	12.000	7.000	13.000
23. LEATHER &'c	22.000	27.000	30.000	27.000	18.000	10.000	19.000	8.000	5.000	5.000	6.000
24. RUBBER &'c	3.000	11.000	8.000	5.000	8.000	10.000	8.000	10.000	10.000	12.000	9.000
25. CHEMICALS	9.000	15.000	11.000	27.000	27.000	26.000	23.000	27.000	24.000	28.000	24.000
26. OILS & FATS	35.000	35.000	34.000	13.000	4.000	5.000	7.000	5.000	3.000	9.000	4.000
27. COCONUT FIBRE & YARN	28.000	9.000	3.000	35.000	33.000	9.000	6.000	11.000	7.000	16.000	8.000
28. PETROLEUM PRODUCTS	17.000	21.000	20.000	16.000	31.000	35.000	35.000	35.000	19.000	35.000	33.000
29. STRUCTURAL CLAY PRODUCTS	2.000	3.000	6.000	20.000	20.000	21.000	30.000	17.000	25.000	24.000	23.000
30. CERAMICS	10.000	6.000	17.000	2.000	2.000	17.000	24.000	20.000	9.000	23.000	18.000
31. CEMENT &'c	19.000	23.000	25.000	7.000	12.000	8.000	11.000	2.000	2.000	4.000	2.000
32. BASIC METALS	12.000	16.000	16.000	22.000	22.000	16.000	14.000	7.000	8.000	6.000	7.000
33. LIGHT ENGINEERING	26.000	30.000	10.000	15.000	15.000	13.000	14.000	22.000	17.000	22.000	14.000
34. TRANSPORT EQUIPMENT	14.000	22.000	31.000	29.000	23.000	29.000	4.000	29.000	11.000	15.000	27.000
35. MACHINERY &'c	13.000	20.000	25.000	19.000	21.000	22.000	12.000	18.000	33.000	33.000	27.000
36. OTHER MANUFACTURING	24.000	17.000	28.000	23.000	34.000	18.000	29.000	16.000	21.000	18.000	16.000

TABLE 16. ... OF SECTORS ACCORDING TO ... INPUT-OUTPUT EFFECTS (DIRECT AND INDIRECT PLUS INDUCED) PER UNIT OF IMPORTS

	GROSS OUTPUT	EMPLOYMENT	IMPORTS	SAVINGS	GOVERNMENT REVENUE	VALUE-ADDED	OTHER INCOMES	TOTAL HOUSEHOLD INCOME	ESTATE INCOME	RURAL INCOME	URBAN INCOME
1. TEA	18.000	2.000	1.000	27.000	23.000	16.000	24.000	12.000	1.000	24.000	28.000
2. RUBBER	36.000	9.000	2.000	12.000	17.000	7.000	9.000	10.000	3.000	14.000	11.000
3. COCONUT	17.000	13.000	3.000	7.000	13.000	2.000	1.000	5.000	4.000	6.000	2.000
4. PADDY	10.000	3.000	4.000	2.000	33.000	12.000	36.000	1.000	32.000	1.000	33.000
5. LIVESTOCK	9.000	26.000	5.000	3.000	18.000	4.000	4.000	7.000	5.000	6.000	6.000
6. FISHING	14.000	10.000	6.000	1.000	15.000	1.000	5.000	2.000	9.000	5.000	1.000
7. LOGGING &'c	24.000	20.000	7.000	2.000	21.000	6.000	21.000	3.000	16.000	2.000	12.000
8. OTHER AGRICULTURE	2.000	3.000	8.000	5.000	27.000	3.000	3.000	4.000	6.000	4.000	13.000
9. MINING &'c	28.000	12.000	9.000	8.000	16.000	5.000	2.000	9.000	11.000	12.000	3.000
10. RICE-MILLING	35.000	34.000	10.000	34.000	34.000	34.000	32.000	34.000	34.000	34.000	34.000
11. FLOUR-MILLING	16.000	19.000	11.000	22.000	29.000	20.000	16.000	24.000	8.000	23.000	16.000
12. DAIRY PRODUCTS	29.000	33.000	12.000	33.000	28.000	33.000	31.000	33.000	31.000	33.000	32.000
13. BREAD	15.000	29.000	13.000	32.000	22.000	32.000	29.000	23.000	15.000	32.000	31.000
14. OTHER BAKERY PRODUCTS	8.000	15.000	14.000	23.000	25.000	25.000	23.000	17.000	7.000	19.000	22.000
15. CARBONATED BEVERAGES	6.000	21.000	15.000	16.000	8.000	10.000	7.000	36.000	18.000	17.000	10.000
16. DESSICCATED COCONUT COPRA	23.000	36.000	16.000	36.000	36.000	36.000	35.000	36.000	36.000	36.000	36.000
17. OTHER PROCESSED FOODS	7.000	17.000	17.000	29.000	2.000	27.000	19.000	28.000	10.000	25.000	26.000
18. DISTILLING &'c	4.000	27.000	18.000	26.000	31.000	23.000	13.000	27.000	28.000	30.000	20.000
19. TOBACCO PRODUCTS	1.000	5.000	19.000	9.000	1.000	8.000	8.000	13.000	14.000	13.000	9.000
20. TEXTILES	26.000	7.000	20.000	21.000	12.000	28.000	26.000	21.000	22.000	15.000	25.000
21. WOOD PRODUCTS	25.000	4.000	21.000	14.000	26.000	21.000	28.000	14.000	26.000	10.000	23.000
22. PAPER &'c	22.000	16.000	22.000	13.000	9.000	13.000	15.000	16.000	20.000	16.000	8.000
23. LEATHER &'c	13.000	28.000	23.000	28.000	20.000	31.000	27.000	29.000	19.000	27.000	24.000
24. RUBBER &'c	33.000	14.000	24.000	15.000	14.000	14.000	14.000	18.000	17.000	18.000	4.000
25. CHEMICALS	27.000	22.000	25.000	19.000	7.000	18.000	34.000	20.000	35.000	20.000	14.000
26. OILS & FATS	31.000	35.000	26.000	35.000	35.000	35.000	11.000	35.000	2.000	35.000	35.000
27. COCONUT FIBRE & YARN	11.000	25.000	27.000	11.000	32.000	17.000	30.000	6.000	30.000	3.000	30.000
28. PETROLEUM PRODUCTS	34.000	32.000	28.000	31.000	30.000	29.000	18.000	31.000	13.000	31.000	29.000
29. STRUCTURAL CLAY PRODUCTS	32.000	11.000	29.000	7.000	19.000	9.000	17.000	8.000	24.000	9.000	7.000
30. CERAMICS	21.000	30.000	30.000	10.000	11.000	11.000	22.000	30.000	27.000	28.000	15.000
31. CEMENT &'c	30.000	30.000	31.000	30.000	11.000	22.000	6.000	22.000	12.000	22.000	27.000
32. BASIC METALS	30.000	18.000	32.000	20.000	5.000	24.000	20.000	25.000	25.000	26.000	17.000
33. LIGHT ENGINEERING	3.000	31.000	33.000	24.000	6.000	19.000	12.000	26.000	29.000	29.000	18.000
34. TRANSPORT EQUIPMENT	19.000	24.000	34.000	25.000	4.000	30.000	25.000	19.000	21.000	21.000	19.000
35. MACHINERY &'c	12.000	23.000	35.000	18.000	3.000	15.000	10.000	15.000	23.000	11.000	5.000
36. OTHER MANUFACTURING	5.000	8.000	36.000	17.000	25.000	26.000	33.000				21.000

relatively little income, and relatively less employment.

Taking the Value-Added series, the rank correlation coefficient between the Semi-Input Output results of Table 18, and the first 36 activities of the no capacity unconstrained model results of Table 11, is only .371. Normalising the results against imports, as in Tables 19 and 12, yields no greater correlation, the coefficient for the respective value-added rankings being .362.

The choice of constraint, nature of model assumed, and view of trading possibilities clearly, therefore, play an important role in defining the relative attractiveness of economic activities.

In Table 20a we present the matrix of rank correlation coefficients between ten objectives, for the results as normalised against imports. Table 21a gives the same matrix for the semi-aggregated results presented in the earlier paper.

Again, especially for the semi-aggregated model results, many of the coefficients are not statistically significant. Nevertheless, the overall picture derived from the earlier model with capacity constraints is sustained, urban income is more highly correlated with 'other institutions income' (profits), and Government Revenue, while rural income is more highly correlated with employment.

However, unlike the case in the results with no capacity constraint, and the results of the semi-aggregated semi I/O model, the

Table 20a

Fully Disaggregated , 48 activity, Semi-Input Output Model

Matrix of rank correlation coefficients for
activities ranked by various objectives achieved per unit of imports

OBJECTIVE BY WHICH ACTIVITIES ARE RANKED

OBJECTIVE CORRELATED WITH	Urban Income	Rural Income	Estate Income	Total Household Income	Other Inst. Income	Value Added	Govnt. Revenue	Savings	Employment	Gross Output
Urban Income	1.00	0.55	0.52	0.61	0.81	0.81	0.53	0.72	0.40	0.10
Rural Income		1.00	0.53	0.96	0.31	0.82	0.12	0.95	0.72	0.23
Estate Income			1.00	0.60	0.52	0.64	0.29	0.52	0.48	0.21
Total Household Income				1.00	0.40	0.90	0.11	0.96	0.74	0.21
Other Institutions Income					1.00	0.73	0.47	0.48	- 0.19	0.19
Value Added						1.00	0.26	0.91	0.60	0.21
Government Revenue							1.00	0.20	0.24	0.15
Savings								1.00	0.68	0.19
Employment									1.00	0.17
Gross Output										1.00

(Co-efficients outside the range $\pm$ 0.33 are significant at the 95% confidence level)

Table 20b

Fully Disaggregated, 48 Activity, Semi-Input Output Model

Matrix of rank correlation co-efficients for
activities ranked by various objectives achieved per unit of capital

OBJECTIVE BY WHICH ACTIVITIES ARE RANKED

OBJECTIVES CORRELATED WITH	Urban Income	Rural Income	Estate Income	Total Household Income	Other Inst. Income	Value Added	Govnt. Revenue	Savings	Imports	Employ- ment	Gros Outpu
Urban Income	1.00	0.63	0.57	0.74	0.82	0.80	0.49	0.81	0.40	0.29	0.51
Rural Income		1.00	0.56	0.93	0.35	0.86	0.17	0.93	0.29	0.71	0.44
Estate Income			1.00	0.71	0.53	0.76	0.34	0.64	0.47	0.48	0.50
Total Household Income				1.00	0.49	0.97	0.27	0.96	0.43	0.65	0.55
Other Instit. Income					1.00	0.64	0.43	0.55	0.27	0.10	0.37
Value Added						1.00	0.33	0.96	0.46	0.54	0.57
Govnt. Revenue							1.00	0.32	0.32	0.16	0.43
Savings								1.00	0.43	0.56	0.56
Imports									1.00	0.14	0.29
Employment										1.00	0.91
Gross Output											1.00

(Co-efficients outside the range $\pm$ 0.33 are significant at the 95% confidence level)

Table 21a

Semi-Aggregated, 12 Activity, Semi-Input Output Model

Matrix of rank correlation coefficients
for activities ranked by various objectives achieved per unit of imports

OBJECTIVE BY WHICH ACTIVITIES ARE RANKED

OBJECTIVES CORRELATED WITH	Urban Income	Rural Income	Estate Income	Total Household Income	Other Inst. Income	Value Added	Govnt. Revenue	Savings	Employment	Gross Output
Urban Income	1.00	0.33	0.50	0.27	0.97	0.55	0.51	0.35	-0.10	0.55
Rural Income		1.00	0.20	0.90	0.27	0.43	-0.04	0.98	0.60	0.43
Estate Income			1.00	0.38	0.53	0.50	-0.01	0.30	0.40	0.50
Total Household Income				1.00	0.22	0.48	-0.14	0.95	0.75	0.48
Other Institutions Income					1.00	0.63	0.43	0.30	-0.23	0.63
Value Added						1.00	0.03	0.48	-0.03	1.00
Govnt. Revenue							1.00	-0.13	-0.34	0.03
Savings								1.00	0.65	0.48
Employment									1.00	-0.03
Gross Output										1.00

(Co-efficients outside the range ± 0.69 are significant at the 95% confidence level)

Table 21b

Semi-Aggregated, 12 Activity, Semi-Input Output Model

Matrix of rank correlation coefficients
for activities ranked by various objectives achieved per unit of capital

OBJECTIVE BY WHICH ACTIVITIES ARE RANKED

39.

OBJECTIVES CORRELATED WITH	Urban Income	Rural Income	Estate Income	Total Household Income	Other Inst. Income	Value Added	Govnt. Revenue	Savings	Imports	Employ-ment	Gross Output
Urban Income	1.00	0.25	0.39	0.20	0.93	0.28	0.23	0.28	0.07	-0.15	0.25
Rural Income		1.00	-0.10	0.90	0.12	0.87	0.10	0.98	-0.40	0.71	0.68
Estate Income			1.00	0.11	0.41	0.19	-0.22	0.002	0.49	0.10	-0.10
Total Household Income				1.00	0.03	0.93	-0.02	0.95	-0.53	0.87	0.72
Other Instit. Income					1.00	0.17	0.12	0.15	0.23	-0.32	0.07
Value Added						1.00	-0.15	0.93	-0.47	0.69	0.78
Govnt. Revenue							1.00	-0.00	-0.50	-0.10	0.28
Savings								1.00	-0.42	0.75	0.72
Imports									1.00	-0.45	-0.82
Employment										1.00	0.43
Gross Output											1.00

(Co-efficients outside the range $\pm$ 0.69 are significant at the 95% confidence level)

full system results of Table 20a show urban incomes as having a slightly lower correlation with value added than rural incomes (the difference, of course, not being significant.)

Table 22 presents results on the maximum and average distances between coefficients, for various objectives. Normalising with respect to imports tends to reduce the disparities between activities, but nevertheless, to take the example of value added, each of the 36 sectors' effects is 4.7% larger than the next sector in the rank order, while in the case of employment this distance is 8.7%.

Finally in Tables 23 and 24 we present the coefficients of the full semi-input output model normalised against capital requirements, and sector rankings, on the alternative assumption that capital, rather than imports is the constraining factor on economic expansion.

Such an alternative normalisation does yield significantly different results. The rank correlation coefficient (in the case of value-added) between the non-normalised results, and results normalised against capital is only 0.027, while between results normalised against imports, and against capital it is 0.605. Thus again the results stress the importance in analysis of correctly specifying the constraints. In Part 2 we will consider the possibility of allowing for multiple constraints.

In terms of conflicts between objectives, the Rank Correlation Matrices (Tables 20b and 21b) for the results normalised with respect to capital show the same characteristics as the results normalised with respect to imports.

Table 22.

Distance between Sectors from the Viewpoint of Various Objectives – Fully Disaggregated, 48 Activity, Semi-Input Output Model

	Comprehensive Effect		Normalised w.r.t. Imports		Normalised w.r.t Capital	
	Max.	Average	Max.	Average	Max.	Average
Urban Income	10.45	1.073	4.93	1.048	4.13	1.044
Rural Income	12.92	1.079	9.41	1.070	10.01	1.074
Estate Income	120.00	1.179	87.00	1.202	78.00	1.175
Total Household Income	12.30	1.078	5.19	1.050	5.52	1.052
Other Institutions Income	14.89	1.085	5.69	1.052	7.35	1.063
Value Added	11.79	1.078	4.61	1.047	4.67	1.046
Government Revenue	10.74	1.072	29.66	1.126	24.89	1.121
Savings	11.50	1.076	4.02	1.049	5.13	1.049
Imports	8.32	1.070	–	–	4.83	1.048
Employment	19.67	1.092	14.65	1.087	15.90	1.089
Gross Output	2.26	1.024	3.67	1.041	6.49	1.058

TABLE 15: INPUT-OUTPUT EFFECTS (DIRECT plus INDIRECT plus INDUCED) per unit of CAPITAL

	URBAN INCOME	RURAL INCOME	ESTATE INCOME	TOTAL HOUSEHOLD INCOME	OTHER INCOMES	VALUE-ADDED	GOVERNMENT REVENUE	SAVINGS	IMPORTS	EMPLOYMENT	GROSS OUTPUT
1. TEA	0.148	0.163	0.156	0.468	0.166	0.634	0.062	0.047	0.448	0.283	0.533
2. RUBBER	0.135	0.150	0.021	0.305	0.166	0.471	0.048	0.041	0.289	0.090	0.232
3. COCONUT	0.208	0.229	0.013	0.450	0.269	0.719	0.069	0.063	0.380		0.472
4. PADDY	0.132	0.741	0.002	0.877	0.081	0.959	0.064	0.109	0.656	0.063	0.719
5. LIVESTOCK	0.230	0.290	0.014	0.535	0.285	0.820	0.074	0.074	0.467	0.461	0.667
6. FISHING	0.226	0.219	0.005	0.450	0.203	0.653	0.061	0.065	0.341	0.072	0.449
7. LOGGING &'c	0.181	0.310	0.004	0.495	0.162	0.657	0.058	0.067	0.387	0.103	0.430
8. OTHER AGRICULTURE	0.333	0.515	0.014	0.862	0.439	1.302	0.091	0.118	0.714	0.067	1.336
9. MINING &'c	0.168	0.183	0.004	0.356	0.213	0.569	0.056	0.050	0.334	0.261	0.353
10. RICE-MILLING	0.134	0.121	0.004	0.258	0.161	0.419	0.047	0.037	0.742	0.087	0.687
11. FLOUR-MILLING	0.214	0.188	0.008	0.410	0.261	0.671	0.058	0.059	0.516	0.049	0.662
12. DAIRY PRODUCTS	0.151	0.149	0.006	0.306	0.165	0.472	0.087	0.044	0.732	0.091	0.767
13. BREAD	0.178	0.179	0.028	0.365	0.175	0.540	0.093	0.052	0.674	0.074	0.865
14. OTHER BAKERY PRODUCTS	0.193	0.191	0.009	0.393	0.198	0.591	0.108	0.056	0.488	0.097	0.720
15. CARBONATED BEVERAGES	0.215	0.197	0.005	0.417	0.263	0.680	0.058	0.060	0.447	0.101	0.689
16. DESSICATED COCONUT COPRA	0.170	0.152	0.005	0.326	0.198	0.525	0.060	0.047	1.265	0.075	1.411
17. OTHER PROCESSED FOODS	0.154	0.155	0.006	0.316	0.198	0.514	0.253	0.045	0.441	0.061	0.667
18. DISTILLING &'c	0.347	0.281	0.008	0.635	0.463	1.099	0.091	0.093	0.874	0.082	1.506
19. TOBACCO PRODUCTS	0.234	0.261	0.006	0.500	0.278	0.778	0.672	0.071	0.483	0.133	1.422
20. TEXTILES	0.122	0.156	0.004	0.282	0.114	0.396	0.066	0.039	0.343	0.166	0.371
21. WOOD PRODUCTS	0.143	0.208	0.003	0.355	0.108	0.463	0.046	0.049	0.361	0.115	0.397
22. PAPER &'c	0.145	0.134	0.003	0.282	0.151	0.433	0.065	0.041	0.298	0.126	0.336
23. LEATHER &'c	0.196	0.170	0.004	0.370	0.171	0.541	0.080	0.054	0.517	0.059	0.691
24. RUBBER &'c	0.184	0.152	0.004	0.340	0.192	0.532	0.065	0.050	0.366	0.077	0.370
25. CHEMICALS	0.141	0.121	0.004	0.266	0.168	0.434	0.070	0.050	0.312	0.076	0.334
26. OILS & FATS	0.091	0.081	0.002	0.174	0.104	0.279	0.031	0.039	0.577	0.052	0.595
27. COCONUT FIBRE & YARN	0.176	0.481	0.048	0.705	0.150	0.856	0.060	0.025	0.610	0.032	0.839
28. PETROLEUM PRODUCTS	0.084	0.074	0.002	0.159	0.126	0.285	0.027	0.087	0.262	0.097	0.259
29. STRUCTURAL CLAY PRODUCTS	0.176	0.215	0.004	0.395	0.181	0.576	0.056	0.023	0.360	0.029	0.367
30. CERAMICS	0.157	0.230	0.004	0.391	0.155	0.546	0.076	0.056	0.372	0.107	0.421
31. CEMENT &'c	0.106	0.101	0.003	0.211	0.183	0.394	0.060	0.054	0.310	0.126	0.361
32. BASIC METALS	0.155	0.143	0.005	0.302	0.162	0.464	0.076	0.030	0.374	0.042	0.391
33. LIGHT ENGINEERING	0.210	0.178	0.005	0.393	0.271	0.664	0.103	0.043	0.509	0.068	0.307
34. TRANSPORT EQUIPMENT	0.169	0.135	0.004	0.307	0.146	0.453	0.132	0.057	0.416	0.061	0.497
35. MACHINERY &'c	0.196	0.152	0.004	0.353	0.215	0.568	0.117	0.045	0.392	0.068	0.526
36. OTHER MANUFACTURING	0.119	0.169	0.003	0.291	0.063	0.354	0.111	0.052	0.300	0.099	0.480

TABLE ... : RANKING OF SECTORS ACCORDING TO SIZE OF SEMI INPUT-OUTPUT EFFECTS (DIRECT plus INDIRECT plus INDUCED) per unit of ...

#	Sector	URBAN INCOME	RURAL INCOME	ESTATE INCOME	TOTAL HOUSEHOLD INCOME	OTHER INCOMES	VALUE-ADDED	GOVERNMENT REVENUE	SAVINGS	IMPORTS	EMPLOYMENT	GROSS OUTPUT
1.	TEA	25.000	21.000	1.000	8.000	21.000	13.000	21.000	23.000	16.000	2.000	18.000
2.	RUBBER	29.000	27.000	3.000	27.000	22.000	25.000	31.000	28.000	35.000	16.000	36.000
3.	COCONUT	9.000	9.000	6.000	10.000	6.000	7.000	16.000	9.000	22.000	18.000	22.000
4.	PADDY	31.000	1.000	14.000	1.000	35.000	3.000	20.000	2.000	7.000	1.000	5.000
5.	LIVESTOCK	4.000	5.000	4.000	5.000	3.000	5.000	14.000	5.000	15.000	24.000	15.000
6.	FISHING	5.000	10.000	17.000	9.000	11.000	12.000	22.000	8.000	20.000	10.000	23.000
7.	LOGGING &'c	14.000	4.000	20.000	7.000	12.000	11.000	26.000	7.000	21.000	27.000	24.000
8.	OTHER AGRICULTURE	2.000	2.000	5.000	2.000	25.000	1.000	9.000	1.000	5.000	3.000	32.000
9.	MINING &'c	20.000	16.000	21.000	19.000	2.000	16.000	29.000	19.000	30.000	17.000	
10.	RICE-MILLING	30.000	33.000	27.000	33.000	10.000	31.000	32.000	33.000	3.000	33.000	32.000
11.	FLOUR-MILLING	7.000	15.000	8.000	12.000	26.000		27.000	11.000	11.000	15.000	
12.	DAIRY PRODUCTS	24.000	28.000	9.000	26.000	8.000	9.000	31.000	26.000	4.000	23.000	16.000
13.	BREAD	15.000	17.000	7.000	18.000	23.000	24.000	8.000	18.000	6.000	13.000	9.000
14.	OTHER BAKERY PRODUCTS	12.000	14.000	15.000	15.000	5.000	20.000	6.000	13.000	13.000	11.000	
15.	CARBONATED BEVERAGES	6.000	13.000	19.000	11.000	13.000	14.000	28.000	10.000	17.000	22.000	
16.	DESSICATED COCONUT COPRA	18.000	26.000	12.000	23.000	7.000	8.000	25.000	22.000	1.000	30.000	12.000
17.	OTHER PROCESSED FOODS	23.000	23.000	19.000	24.000	12.000	22.000	2.000	25.000	18.000	19.000	
18.	DISTILLING &'c	1.000	6.000	13.000	4.000	14.000	23.000		3.000	2.000	5.000	14.000
19.	TOBACCO PRODUCTS	3.000	7.000	28.000	6.000	15.000	2.000	1.000	6.000	14.000	4.000	
20.	TEXTILES	32.000	22.000	31.000	30.000	4.000	6.000	17.000	31.000	28.000	28.000	2.000
21.	WOOD PRODUCTS	27.000	12.000	32.000	20.000	32.000	32.000	33.000	21.000	26.000	6.000	28.000
22.	PAPER &'c	26.000	31.000	25.000	31.000	33.000	27.000	19.000	29.000	34.000	31.000	6.000
23.	LEATHER &'c	10.000	19.000	24.000	17.000	28.000	30.000	12.000	16.000	10.000	20.000	33.000
24.	RUBBER &'c	13.000	25.000	30.000	22.000	19.000	19.000	18.000	20.000	25.000	21.000	11.000
25.	CHEMICALS	28.000	32.000	35.000	32.000	15.000	21.000	15.000	32.000	31.000	32.000	29.000
26.	OILS & FATS	35.000	35.000	36.000	35.000	20.000	29.000	35.000	35.000	9.000	35.000	34.000
27.	COCONUT FIBRE & YARN	16.000	3.000	22.000	3.000	34.000	36.000	23.000	4.000	8.000	14.000	17.000
28.	PETROLEUM PRODUCTS	36.000	36.000	26.000	36.000	29.000	35.000	36.000	36.000	36.000	36.000	8.000
29.	STRUCTURAL CLAY PRODUCTS	17.000	11.000	34.000	15.000	31.000	15.000	33.000	14.000	27.000	9.000	35.000
30.	CERAMICS	21.000	8.000	18.000	6.000	17.000	18.000	30.000	34.000	24.000	7.000	30.000
31.	CEMENT &'c	34.000	34.000	16.000	34.000	27.000	33.000	24.000	27.000	32.000	34.000	25.000
32.	BASIC METALS	22.000	29.000	29.000	28.000	16.000	26.000		12.000	23.000	26.000	31.000
33.	LIGHT ENGINEERING	19.000	18.000	23.000	14.000		10.000		24.000	12.000	29.000	27.000
34.	TRANSPORT EQUIPMENT	11.000	30.000	16.000	25.000	5.000	28.000	3.000	17.000	19.000	25.000	6.000
35.	MACHINERY &'c	33.000	24.000	29.000	21.000	9.000	17.000	4.000	30.000	20.000	28.000	20.000
36.	OTHER MANUFACTURING	31.000	20.000	33.000	29.000	36.000	34.000	34.000				19.000

PART 2.   7. Analysis of Multiple Objectives

There is, of course, no constraint which forces governments to have only one objective of economic policy. In the normal case of multiple objectives, the government's choices depend upon the relative weight attached to the different objectives. The "rational" decision - making authority will implicitly, though rarely explicitly, have a multi-dimensional objective function describing a set of trade-offs between objectives. This in turn will be confronted by a set of production possibilities as defined by the characteristics of the various economic activities.

Without a prior knowledge of the Governments objective function, a unique ranking of activities will not be possible. However, certain steps can be made to delimit the choice problem without such prior knowledge of 'welfare criteria' (other than, more is preferred to less, of any objective). It is to this which we now turn.

8.   Absolute Dominance

Obviously, if an activity ranks higher than another, for all relevant objectives, it absolutely dominates that sector irrespective of any objective function.

If we take our no-capacity constraint model of Part 1, and incorporate the foreign exchange constraint assumption, then the results of Table 9 represent the range of "production possibilities" achievable

by expanding any of the 48 activities identified, while Table 12 represents
their rank order for each of ten conceivable objectives. Table 25 selects
four of these potential objectives (value-added, total household incomes,
rural household income and employment) and lists the activities by their
rank order for each objective. The lines drawn then trace the movement
of activities through the rankings as objectives change. So, for example,
sector 28 (Petroleum and coal products) ranks 1st in terms of value-added,
9th in terms of household income, 22nd in terms of rural income and 23rd in
terms of employment. Every crossing over of objectives implies that no
absolute dominance can be established by one sector over the other, while
a clear choice can be made (assuming only these four objectives specified
are relevant) between all sectors whose lines do not cross over at any
point.

Thus we can conclude that Paddy(4) is preferable to all the
activities listed below it in the Value-Added column. Leather and Leather
Products (23) is preferred to all activities below it in the value-added
column other than activities 40, 1, 30, 36, and 48, and is dominated by all
sectors above it in the value-added column, other than 31. Thus in only
6 out of 47 other activities does a conflict of objectives arise in the
choice between Leather and Leather Products and alternative activities.

Thus, by this very simple method, progress can be made in
delimiting the choice problem from the partial viewpoint of the choice
between one sector and any other.

Table 25.   Changes in the Rank Order of Activities {1 – 48}*
with changes in the Welfare Objective

RANK ORDER	VALUE ADDED	TOTAL HOUSEHOLD INCOME	RURAL HOUSEHOLD INCOME	TOTAL EMPLOYMENT
1.	28	42	4	4
2.	41	29	7	10
3.	16	47	10	2
4.	3	7	27	21
5.	26	41	29	1
6.	38	6	21	29
7.	6	21	47	42
8.	5	27	42	19
9.	42	28	5	45
10.	29	16	6	6
11.	19	3	3	9
12.	47	5	16	8
13.	9	26	44	44
14.	8	4	8	30
15.	7	10	9	24
16.	27	46	26	38
17.	43	19	41	16
18.	46	44	19	3
19.	37	9	45	41
20.	18	38	2	26
21.	21	43	46	43
22.	44	8	28	46
23.	45	45	38	28
24.	2	2	43	27
25.	10	39	30	36
26.	4	37	37	37
27.	24	24	39	39
28.	39	18	40	7
29.	31	40	24	48
30.	23	1	36	40
31.	40	23	18	5
32.	1	30	23	18
33.	30	36	1	47
34.	36	22	22	23
35.	22	48	31	20
36.	25	31	48	22
37.	15	25	17	31
38.	17	15	14	17
39.	48	14	25	14
40.	33	17	15	25
41.	14	33	20	15
42.	35	20	33	34
43.	20	35	34	33
44.	34	34	35	32
45.	11	32	32	35
46.	32	11	11	11
47.	12	12	12	13
48.	13	13	13	12

*

See Table 2 for a listing of activities with their reference numbers, 1 – 48.

9. The Production Possibility Frontier

Given the fixed linear relationships underlying our models, the choice problem can be simplified even further. From the range of production possibilities, we can define an n – dimensional production possibility frontier, for the n objectives, representing the potential production of a set of technically efficient activities, a subset of the total number of activities, from which the "best" sector, or combination of sectors, must be chosen by any "rational" objective function.

This is best illustrated by an example of the case with two objectives only, namely value-added and employment. (Assuming still that we have just the one constraint, foreign exchange). Diagram 'A' positions the 48 sectors in a two-dimensional space by reference to the value-added and employment, they generate per unit of imports required.* In our linear model, the production possibility frontier is given by the linear combination of activities which are (a) dominated by no other activities, (b) dominated by no linear combination of other activities. In Graph A we can clearly see that these conditions are met by the activities 4 and 28 (Paddy, and Petroleum and Coal Products) and the linear combination of these two activities provides the frontier. Retail Trade (42) is dominated neither by Paddy nor by Petroleum and Coal Products, but is dominated by a linear combination of them.

The precise mixture of Paddy and Petroleum and Coal Products which is "best" still depends on the objective function, on how it weights jobs as opposed to income, but we have defined a subset of just two technically efficient activities, which make up the production possibility frontier.

[* Based on the results presented in Table 9]

Employment (men per thousand Rupees of imports)

Value-Added (in thousands of Rupees per thousand Rupees of imports)

Graph A. Generation of employment and value-added, per unit of imports, via the exogenous expansion of activities

3.0 2.5 2.0 1.5 1.0 .5 0

0 1 2 3 4 5 6 7 8 9 10 11 12

dairy
flour
bread
basic metals
trans. equip
textiles
other bakery
other proces. food
other services
manufactures nes
ceramics
rubber pdcts.
communications
hotels
machinery
light engin.
chemicals
carb. bev.
paper
leather
rail trans.
cement
road pass. trans.
distilling
construction
communications
coconut fibre
logging
other trans.
dwellings
livestock
coconut
oils & fats
D.C.&Copra
petroleum
wholesale trade
electricity
fish
other agric.
mining
tobacco pdcts.
struc. clay pdcts.
retail trade
wood pdcts.
rubber
paddy
rice milling
tea

[PRODUCTION POSSIBILITY FRONTIER]

To illustrate a more complex situation, we have already noted
(footnote p. 11) that the position of the Petroleum and Coal Products is
an artificial one due to abnormally low crude-oil imports in 1970. If we
thus eliminate this activity from our alternatives, then the frontier shifts
down to that comprising Paddy (4), Wood Products (21), Retail Trade (42) and
Wholesale Trade (41). Any objective function (involving value-added and
employment) will pick at most a combination of two adjacent activities as the
"best" activity to expand. (It is of course also possible to isolate
activities close to the frontier).

Where we have more than two objectives, we cannot isolate the
production possibility frontier graphically, but the activities on the
frontier can be selected by finding all the activities which achieve first
ranking for all reasonable objective functions, considered in turn. The
proceedure is illustrated for the two dimensional case in diagram B below;
we assume a range of linear objective functions, 0 to 10, and these identify
3 activities, A,B, C, on the frontier, as these are the only activities that
achieve first ranking for any of the alternate objective functions. The
frontier, once isolated, is of course the same, whether the actual objective
function is linear or not.

Diagram B

Objective 1
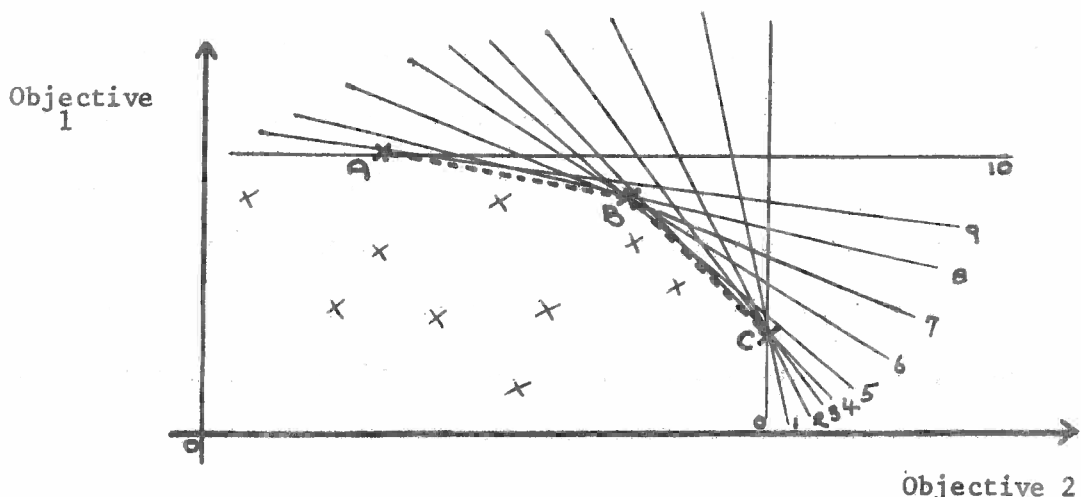
Objective 2

Mathematically, we run through the combinations of alternative weightings for each objective, from 0 to infinity, selecting each time the activity which yields the highest combined welfare "score" for a given set of weights.

In Table 26 we list the activities which enter the production possibility frontier as we add new objectives to the objective function. When the list of objectives is extended to 5, we find 11 activities on the production possibility frontier, some of which are only selected if extreme weights are given to one objective. Thus tea is selected only when estate incomes are the dominant objective of policy.

Given, as we have stated earlier, that our activities are really only guides to the probable characteristics of smaller operational units, the main value of this methodology must be to allow a more efficient allocation of the skilled manpower engaged in planning, research and data collection.

The complaint is often heard that it is a shortage of suitable projects, rather than investable funds, which limits investment in many developing countries, and this in turn may be attributed to having too few qualified planners spread thinly over a wide range of activities to assess. Hopefully, our framework would pinpoint in advance areas where successful projects are most likely to be found, and would thus reduce the time 'wasted' in analysing projects which turn out not to be viable. Our foreign exchange constrained model clearly would provide a guide to the most fruitful areas for granting import licences, but does not eliminate the need to examine

Table 26.

Activities appearing on Production
Possibility Frontier, as Range of Objectives is Extended

ADDITIONAL OBJECTIVE CONSIDERED					
Urban Income 1	Rural Income 2	Estate Income 3	Other Inst.Income 4	Employment 5	
Wholesale Trade (41)					ACTIVITIES ADDED TO PRODUCTION POSSIBILIT FRONTIER
	Paddy (4) Logging (7) Retail Trade (42)				
		Tea (1) Coconut Fibre (27) Dwellings (47)			
			Petroleum Pdcts.(28)		
				Rubber (2) Wood Pdts. (21) Struc. Clay(29)	

each operational unit, which may differ from the general activity to which it belongs.

10. A Capital-Constrained Model

To illustrate the choice problem with a capital constraint, we have devised a simple extension of the no-capacity constraint model whereby acts of investment to generate a unit increase of output of each activity are compared. Because we continue to assume spare capacity there are no indirect capital requirements. The total effects of expanding one activity now comprise of:-

1/ The direct, intermediate, and induced effects of the unit extra output of the expanding activity.

2/ The direct, intermediate, and induced effects of the extra output from capital goods supplying activities.

For these illustrative purposes we continue to use the disaggregated capital/output ratios of Table 15, and we further assume that domestic activities supply all the capital requirements (in fact, domestic activities supplied 84.4% of capital goods requirements in 1970.)

In any real, substantive planning exercise, the share of imports in supplying capital goods would, of course, be a planning variable, subject to optimisation.

We can illustrate the nature of this model with respect to the tea activity. Expanding tea output by one unit,(as shown in Table 15), involves investment of 1.02 units of which .10 units are supplied by Transport Equipment (34), .39 units by Machinery etc., (35), .47 units by Construction (37) and .06 units by Wholesale Trade (41).

Table 6 gives the total direct and indirect effects of expanding these capital goods supplying activities and from this we see that the total value-added generated by expanding tea output now becomes –

Tea	:	1.00 x 1.737	=	1.737
+Transport Equip,	:	0.10 x 0.834	=	0.083
+Machinery etc.	:	0.39 x 0.893	=	0.348
+Construction	:	0.47 x 1.439	=	0.676
+Wholesale Trade	:	0.06 x 1.480	=	0.088
			$\sum$	2.932

To calculate the full set of effects on all the objectives, by all the activities we multiply the data of Table 6 by a 48 x 48 unit matrix to which has been added, to the appropriate rows the capital matrix of Table 15.

Table 27 presents the derived set of comprehensive effects following the expansion of activities, with an initial investment requirement.

TABLE 27 : DIRECT plus INDIRECT plus INDUCED EFFECTS, FOLLOWING UNIT EXPANSION OF SECTOR WITH INITIAL INVESTMENT REQUIREMENT

	URBAN INCOME	RURAL INCOME	ESTATE INCOME	TOTAL HOUSEHOLD INCOME	OTHER INCOMES	VALUE-ADDED	GOVERNMENT REVENUE	SAVINGS	IMPORTS	EMPLOYMENT	GROSS OUTPUT
1. TEA	0.702	1.061	0.498	2.261	0.672	2.934	0.422	0.252	0.674	1.222	2.824
2. RUBBER	2.288	3.232	0.278	5.798	2.457	8.256	1.279	0.776	1.687	1.991	7.666
3. COCONUT	0.833	1.240	0.062	2.135	0.999	3.135	0.351	0.289	0.420	0.577	2.563
4. PADDY	0.394	1.738	0.026	2.158	0.270	2.428	0.254	0.272	0.425	1.082	2.313
5. LIVESTOCK	0.646	1.037	0.047	1.729	0.744	2.473	0.293	0.233	0.350	0.399	2.220
6. FISH	1.102	1.410	0.037	2.548	0.851	3.400	0.510	0.355	0.644	0.780	3.005
7. LOGGING AND FIREWOOD	1.013	2.002	0.042	3.057	0.836	3.893	0.485	0.409	0.649	0.717	3.514
8. OTHER AGRIC	0.435	0.791	0.024	1.249	0.527	1.777	0.170	0.168	0.255	0.430	1.396
9. MINING	1.142	1.654	0.044	2.840	1.311	4.152	0.551	0.391	0.707	0.891	3.753
10. RICE MILLING	0.620	1.898	0.033	2.551	0.511	3.062	0.377	0.329	0.573	1.152	3.840
11. FLOUR MILLING	0.574	0.667	0.026	1.266	0.622	1.888	0.254	0.177	0.737	0.369	1.482
12. DAIRY PRODUCTS	0.430	0.596	0.025	1.050	0.441	1.491	0.280	0.144	0.794	0.295	1.618
13. BREAD	0.435	0.550	0.021	1.006	0.393	1.399	0.291	0.140	0.836	0.312	1.353
14. OTHER BAKERY	0.578	0.735	0.031	1.344	0.549	1.893	0.394	0.186	0.591	0.415	1.950
15. CARBONATED BEVERAGES	0.481	0.565	0.016	1.062	0.536	1.598	0.202	0.149	0.473	0.268	1.351
16. DESSICATED COCONUT & COPRA	0.511	0.762	0.045	1.318	0.610	1.928	0.220	0.178	0.272	0.340	2.391
17. OTHER PROCESSED FOOD	0.505	0.660	0.026	1.191	0.558	1.749	0.661	0.165	0.466	0.367	1.856
18. DISTILLING	0.486	0.531	0.017	1.033	0.597	1.631	0.192	0.146	0.284	0.281	1.559
19. TOBACCO PRODUCTS	0.313	0.437	0.012	0.762	0.337	1.100	0.658	0.105	0.199	0.270	0.974
20. TEXTILES	1.059	1.448	0.040	2.547	0.930	3.477	0.760	0.352	1.258	0.973	3.312
21. WOOD PRODUCTS	1.306	2.170	0.049	3.524	0.945	4.469	0.710	0.480	0.985	1.306	4.750
22. PAPER	1.316	1.547	0.044	2.907	1.256	4.164	0.844	0.408	1.121	0.818	3.848
23. LEATHER &'c	0.727	0.860	0.028	1.615	0.626	2.241	0.405	0.226	0.522	0.432	2.481
24. RUBBER &'c	1.230	1.508	0.071	2.809	1.173	3.982	0.613	0.389	0.744	0.900	3.985
25. CHEMICALS	1.272	1.459	0.045	2.776	1.328	4.105	0.834	0.391	1.077	0.765	3.974
26. OILS & FATS	0.856	1.094	0.053	2.002	0.908	2.911	0.485	0.276	0.650	0.526	4.189
27. COCONUT FIBRE & YARN	0.542	1.367	0.107	2.015	0.498	2.513	0.273	0.255	0.404	0.468	2.436
28. PETROLEUM PRODUCTS	1.608	1.680	0.052	3.340	2.001	5.341	1.023	0.474	1.421	0.872	6.035
29. STRUCTURAL CLAY PRODUCTS	1.295	2.048	0.050	3.394	1.233	4.627	0.594	0.464	0.758	1.117	4.420
30. CERAMICS	0.883	1.506	0.033	2.422	0.808	3.230	0.559	0.329	0.743	0.880	3.060
31. CEMENT	0.974	1.150	0.033	2.158	1.283	3.442	0.725	0.303	0.909	0.609	3.369
32. BASIC METALS	0.916	1.086	0.036	2.037	0.882	2.919	0.704	0.285	0.958	0.593	2.695
33. LIGHT ENGINEERING	0.484	0.531	0.016	1.031	0.541	1.573	0.367	0.146	0.506	0.253	1.470
34. TRANSPORT EQUIPMENT	0.833	0.954	0.027	1.815	0.665	2.480	0.638	0.256	0.851	0.550	2.576
35. MACHINERY	0.733	0.769	0.023	1.525	0.735	2.261	0.502	0.217	0.686	0.398	1.954
36. OTHER MANUFACTURING	0.461	0.790	0.019	1.270	0.266	1.536	0.203	0.172	0.359	0.473	1.628
37. CONSTRUCTION	0.592	0.742	0.022	1.355	0.646	2.002	0.315	0.189	0.390	0.380	1.881
38. ELECTRICITY	2.949	3.658	0.110	6.718	3.412	10.131	1.596	0.938	2.003	1.841	9.165
39. ROAD PASSENGER TRANSPORT	1.737	2.037	0.058	3.833	1.141	4.975	1.327	0.539	1.753	1.162	5.410
40. RAIL TRANSPORT	2.208	2.913	0.083	5.203	1.951	7.155	1.123	0.722	1.562	1.554	7.144
41. WHOLESALE TRADE	0.742	0.883	0.026	1.652	0.819	2.471	0.342	0.232	0.327	0.421	1.971
42. RETAIL TRADE	0.854	1.309	0.041	2.204	0.642	2.846	0.367	0.301	0.409	0.766	2.471
43. OTHER TRANSPORT	0.784	1.020	0.031	1.835	0.744	2.580	0.324	0.255	0.396	0.517	2.254
44. COMMUNICATIONS	1.981	2.332	0.064	4.376	1.736	6.114	1.350	0.615	1.958	1.209	5.495
45. HOTELS &'c	0.761	1.219	0.037	2.017	0.671	2.689	0.336	0.274	0.438	0.724	2.962
46. PROFESSIONAL SERVICES	0.851	1.098	0.039	1.988	0.695	2.684	0.334	0.276	0.415	0.543	2.428
47. DWELLINGS	1.977	2.436	0.109	4.522	1.723	6.246	1.374	0.627	1.935	1.028	5.471
48. OTHER SERVICES	1.902	2.083	0.073	4.059	1.571	5.630	1.419	0.573	2.098	1.273	5.052

Table 28 normalises these results with respect to the investment required (the last column of the capital matrix of Table 15), while Table 29 presents the rankings for four of the objectives.

When capital becomes the constraining resource, it is clear that Paddy (4) and Other Agriculture (2) are the most productive activities. Graph C which identifies activities according to the Value-Added and Employment generated per unit of capital, shows Paddy (4), and Other Agriculture (8), to be in a class of their own. Indeed, when we extend the range of objectives to five, as in section 9, (i.e. urban, rural, estate and other institutions incomes, and employment), Paddy and Other Agriculture still remain the only activities on the production possibility frontier, apart from tea, which only appears when a very high weight is given to estate incomes.

If these activities, i.e. 1, 4, and 8 are excluded, and a set of 'second best' key sectors selected, then this new frontier comprises

10	Rice Milling
16	Dessicated coconut and copra
18	Distilling and blending of spirits
27	Coconut fibre and yarn

Considering both first and second best frontiers, therefore, we can still isolate a subset of 7 out of 48 sectors as being 'technically efficient'.

Graph C. Generation of employment and value-added, per unit of capital, via the exogenous expansion of activities by investment
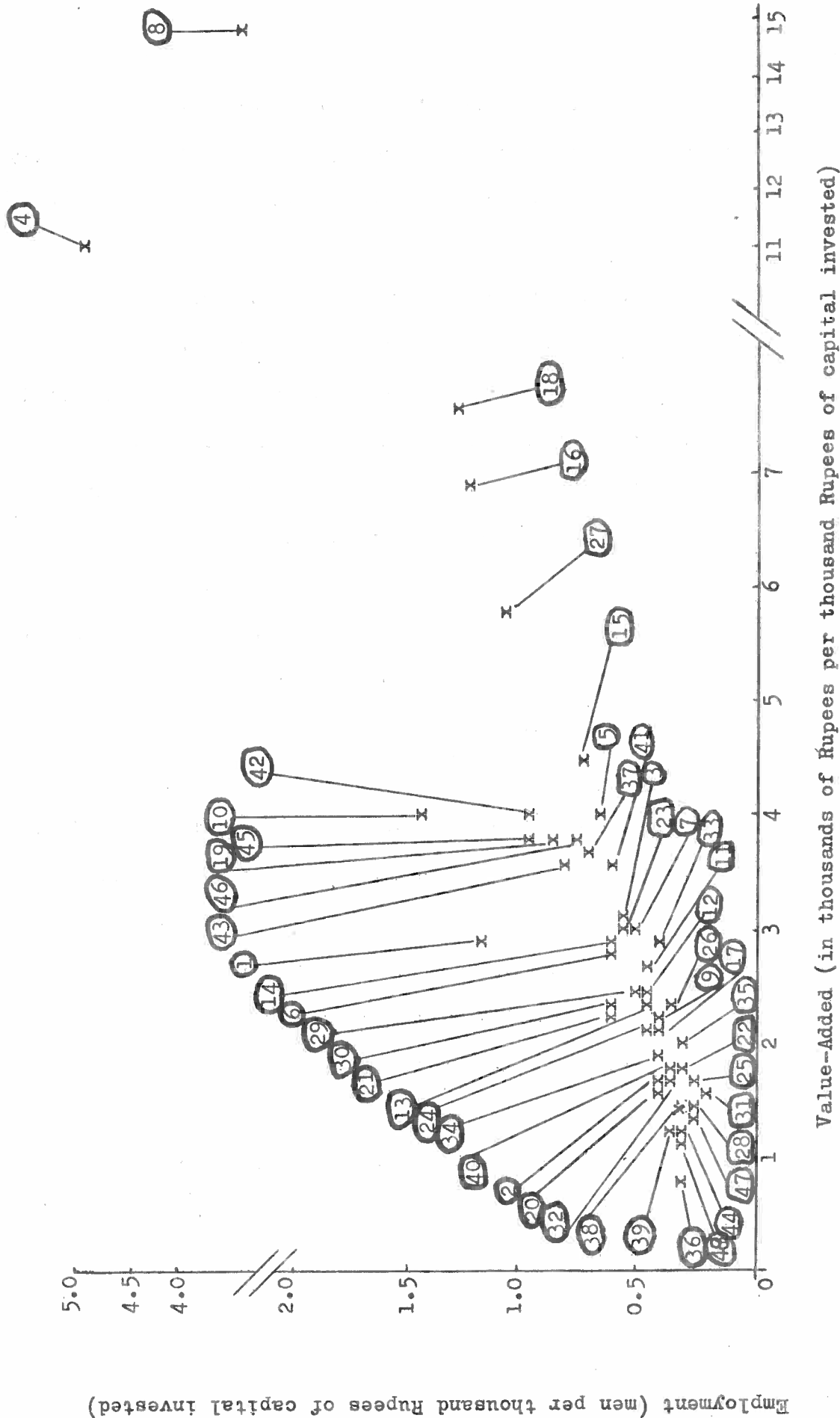
Employment (men per thousand Rupees of capital invested)

5.0 4.5 4.0 2.0 1.5 1.0 0.5 0

Value-Added (in thousands of Rupees per thousand Rupees of capital invested)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

TABLE 28 : DIRECT plus INDIRECT plus INDUCED EFFECTS per unit of CAPITAL

	URBAN INCOME	RURAL INCOME	ESTATE INCOME	TOTAL HOUSEHOLD INCOME	OTHER INCOMES	VALUE-ADDED	GOVERNMENT REVENUE	SAVINGS	IMPORTS	EMPLOYMENT	GROSS OUTPUT
1. TEA	0.688	1.041	0.488	2.217	0.659	2.876	0.414	0.247	0.660	1.198	2.768
2. RUBBER	0.440	0.622	0.054	1.115	0.473	1.588	0.246	0.149	0.324	0.383	1.474
3. COCONUT	0.793	1.181	0.059	2.033	0.952	2.985	0.334	0.276	0.400	0.549	2.441
4. PADDY	1.792	7.901	0.118	9.810	1.226	11.037	1.154	1.235	1.931	4.918	10.512
5. LIVESTOCK	1.041	1.672	0.075	2.789	1.200	3.989	0.472	0.376	0.564	0.643	3.550
6. FISH	0.810	1.037	0.027	1.874	0.626	2.500	0.375	0.261	0.473	0.574	2.209
7. LOGGING AND FIREWOOD	0.734	1.451	0.030	2.215	0.606	2.821	0.352	0.297	0.470	0.519	2.546
8. OTHER AGRIC	3.622	6.592	0.197	10.412	4.391	14.805	1.420	1.398	2.122	3.586	11.636
9. MINING	0.583	0.844	0.023	1.449	0.669	2.118	0.281	0.199	0.360	0.454	1.915
10. RICE MILLING	0.784	2.403	0.042	3.229	0.647	3.876	0.477	0.417	0.725	1.458	4.851
11. FLOUR MILLING	0.726	0.844	0.033	1.603	0.787	2.390	0.321	0.224	0.933	0.467	1.876
12. DAIRY PRODUCTS	0.652	0.902	0.037	1.591	0.668	2.260	0.425	0.218	1.204	0.447	2.452
13. BREAD	0.659	0.833	0.032	1.524	0.596	2.120	0.441	0.211	1.267	0.473	2.050
14. OTHER BAKERY	0.803	1.021	0.043	1.867	0.762	2.630	0.547	0.258	0.820	0.576	2.709
15. CARBONATED BEVERAGES	1.335	1.569	0.045	2.949	1.489	4.439	0.561	0.414	1.313	0.744	3.753
16. DESSICATED COCONUT & COPRA	1.826	2.720	0.162	4.708	2.178	6.887	0.786	0.635	0.971	1.214	8.539
17. OTHER PROCESSED FOOD	0.594	0.777	0.031	1.401	0.657	2.058	0.778	0.194	0.548	0.432	2.183
18. DISTILLING	2.207	2.413	0.077	4.696	2.714	7.412	0.874	0.664	1.293	1.279	7.084
19. TOBACCO PRODUCTS	1.044	1.457	0.040	2.541	1.124	3.665	2.195	0.351	0.664	0.900	3.248
20. TEXTILES	0.461	0.629	0.017	1.107	0.404	1.512	0.330	0.153	0.547	0.423	1.440
21. WOOD PRODUCTS	0.616	1.023	0.023	1.662	0.446	2.108	0.335	0.226	0.465	0.616	2.240
22. PAPER	0.502	0.591	0.017	1.109	0.480	1.589	0.322	0.156	0.428	0.312	1.469
23. LEATHER &c	0.932	1.102	0.036	2.071	0.802	2.874	0.520	0.290	0.670	0.554	3.181
24. RUBBER &c	0.641	0.785	0.037	1.463	0.611	2.074	0.319	0.203	0.388	0.469	2.075
25. CHEMICALS	0.484	0.555	0.017	1.055	0.505	1.561	0.317	0.148	0.410	0.291	1.511
26. OILS & FATS	0.648	0.829	0.040	1.517	0.688	2.205	0.368	0.209	0.492	0.399	3.173
27. COCONUT FIBRE & YARN	1.260	3.178	0.248	4.686	1.158	5.844	0.635	0.592	0.940	1.089	5.666
28. PETROLEUM PRODUCTS	0.410	0.428	0.013	0.852	0.510	1.363	0.261	0.121	0.363	0.223	1.540
29. STRUCTURAL CLAY PRODUCTS	0.632	0.999	0.024	1.655	0.601	2.257	0.290	0.226	0.370	0.545	2.156
30. CERAMICS	0.613	1.046	0.023	1.682	0.561	2.243	0.388	0.228	0.516	0.611	2.125
31. CEMENT	0.439	0.518	0.015	0.972	0.578	1.550	0.326	0.136	0.409	0.274	1.517
32. BASIC METALS	0.501	0.593	0.019	1.113	0.482	1.595	0.385	0.156	0.524	0.324	1.473
33. LIGHT ENGINEERING	0.864	0.948	0.029	1.842	0.966	2.808	0.656	0.260	0.903	0.452	2.625
34. TRANSPORT EQUIPMENT	0.591	0.677	0.019	1.287	0.472	1.759	0.452	0.181	0.604	0.390	1.827
35. MACHINERY	0.643	0.675	0.021	1.338	0.645	1.983	0.441	0.190	0.601	0.349	1.714
36. OTHER MANUFACTURING	0.231	0.395	0.009	0.635	0.133	0.768	0.102	0.086	0.179	0.237	0.814
37. CONSTRUCTION	1.096	1.373	0.041	2.510	1.197	3.708	0.582	0.350	0.722	0.704	3.463
38. ELECTRICITY	0.424	0.526	0.016	0.967	0.491	1.458	0.230	0.135	0.288	0.265	1.319
39. ROAD PASSENGER TRANSPORT	0.462	0.542	0.016	1.019	0.304	1.323	0.353	0.143	0.466	0.309	1.439
40. RAIL TRANSPORT	0.506	0.668	0.019	1.193	0.447	1.641	0.258	0.166	0.358	0.357	1.639
41. WHOLESALE TRADE	1.031	1.227	0.036	2.294	1.138	3.432	0.475	0.322	0.454	0.584	2.738
42. RETAIL TRADE	1.187	1.817	0.056	3.060	0.892	3.953	0.510	0.418	0.568	1.063	3.432
43. OTHER TRANSPORT	1.089	1.417	0.043	2.549	1.034	3.583	0.450	0.354	0.550	0.718	3.131
44. COMMUNICATIONS	0.425	0.500	0.014	0.939	0.373	1.312	0.290	0.132	0.420	0.259	1.179
45. HOTELS &c	1.057	1.693	0.051	2.802	0.932	3.734	0.467	0.381	0.609	1.006	4.114
46. PROFESSIONAL SERVICES	1.182	1.525	0.054	2.761	0.965	3.728	0.464	0.383	0.576	0.755	3.372
47. DWELLINGS	0.424	0.523	0.023	0.970	0.370	1.340	0.295	0.135	0.415	0.221	1.174
48. OTHER SERVICES	0.408	0.447	0.016	0.871	0.337	1.208	0.304	0.123	0.450	0.273	1.085

Table 29.   58.

Rank   of Activities by Achievement

of Various Objectives per Unit of Capital

	Activity	OBJECTIVE			
		Urban Household Income	Rural Household Income	Value Added	Employment
1.	Tea	23	20	17	6
2.	Rubber	41	37	38	35
3.	Coconut	19	17	16	22
4.	Paddy	4	1	2	1
5.	Livestock	13	9	7	15
6.	Fish	17	21	22	20
7.	Logging etc.	21	13	19	24
8.	Other Agriculture	1	2	1	2
9.	Mining etc.	34	27 =	29	28
10.	Rice Milling	20	6	9	3
11.	Flour Milling	22	27 =	23	27
12.	Dairy Products	25	26	24	30
13.	Bread	24	29	28	25
14.	Other Bakery Pdtcs.	18	23	21	19
15.	Carb. Beverages	5	10	6	12
16.	D.C. & Copra	3	4	4	5
17.	Other Proc. Food	32	32	32	31
18.	Distilling Etc.	2	5	3	4
19.	Tobacco Products	12	12	13	10
20.	Textiles	40	36	41	32
21.	Wood Products	30	22	30	16
22.	Paper etc.	36	39	37	39
23.	Leather etc.	15	18	18	21
24.	Rubber Products	28	31	31	26
25.	Chemicals etc.	38	40	39	41
26.	Oils and Fats	26	30	27	33
27.	Coconut Fibre etc.	6	3	5	7
28.	Petroleum etc. Pdts.	46	47	43	47
29.	Struc. Clay Products	29	24	25	23
30.	Ceramics etc.	31	19	26	17
31.	Cement etc.	42	44	40	42
32.	Basic Metals	37	38	36	38
33.	Light Engineering	16	25	20	29
34.	Transport Equipment	33	33	34	34
35.	Machinery etc.	27	34	33	37
36.	Manufacture n.e.s.	48	48	48	46
37.	Construction	9	15	12	14
38.	Electricity	44=	42	41	44
39.	Road Passenger Trans.	39	41	45	40
40.	Rail Transport	35	35	35	36
41.	Wholesale Trade	14	16	15	18
42.	Retail Trade	7	7	8	8
43.	Other Transport	10	14	14	13
44.	Communications	43	45	46	45
45.	Hotels, etc.	11	8	10	9
46.	Prof. Services	8	11	11	11
47.	Dwellings	44 =	43	44	48
48.	Other Services	47	46	47	43

11.   Extension to More than One Constraint

By formulating our proceedure in standard Linear Programming terms we can extend our analysis to cover the case of multiple constraints.

Any cardinal objective function will define units of welfare achieved per unit of output, while we also have data on capital, imports and other scarce factors required per unit of output. All these can be calculated in terms of the comprehensive effects, listed in Table 27.

Given the relative size of the constraints the L.P. technique will select the optimum combination of activities whose expansion will maximise welfare for a given objective function. By running through the full set of objective functions we can again isolate the subset of technically efficient activities from which any given objective function will select an optimum activity (ies).*

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*

In selecting and expanding such key sectors there are of course indirect expansionary repercussions on virtually all the other activities within the economy, and thus our selection proceedure does not imply complete specialisation.

Thus the problem is:

$$\text{Max.} \quad \sum_{i=1}^{n} a_i x_i$$

where x_i = activity output

a_i = welfare produced per unit of output x_i

n = number of activities

Subject to

$$\sum_{i=1}^{n} (k_{ij} x_i) \leq \bar{K}_j \quad \text{as } j = 1 \text{ to } m$$

where $\bar{K}_j$ = level of constraint j available

m = number of constraints

k_{ij} = constraint K_j required per unit of output x_i

Given $\quad a_i = \sum_{j=1}^{L} w_j b_{ij}$

where b_{ij} = objective j created per unit of output x_i

w_j = welfare weight given to objective j

L = number of objectives in objective function

Table 30 presents the required data for three constraints - capital, imports and "skilled labour" (Professional and Managerial workers), and two objectives, value-added and employment.

While not affecting the solution in any way, the co-efficients of Table 30 are in terms of objective/constraint per unit of total direct and indirect activity output. For example, expanding tea output directly by 1 unit will lead to an indirect expansion of the demand for tea, in fact by

TABLE 30. DATA FOR LINEAR PROGRAMMING EXERCISE (UNITS OF CONSTRAINTS and OBJECTIVES PER UNIT OF SECTOR OUTPUT)

	CONSTRAINTS			OBJECTIVES	
	CAPITAL	IMPORTS	SKILL	INCOME	EMPLOYMENT
1. TEA	1.004	0.663	0.033	2.888	1.203
2. RUBBER	5.170	1.677	0.088	8.208	1.979
3. COCONUT	0.976	0.390	0.032	2.913	0.536
4. PADDY	0.172	0.332	0.022	1.899	0.846
5. LIVESTOCK	0.594	0.335	0.021	2.372	0.382
6. FISH	1.284	0.608	0.035	3.209	0.737
7. LOGGING AND FIREWOOD	1.331	0.626	0.037	3.755	0.691
8. OTHER AGRIC	0.100	0.211	0.012	1.474	0.357
9. MINING	1.834	0.661	0.042	3.885	0.833
10. RICE MILLING	0.632	0.459	0.029	2.450	0.922
11. FLOUR MILLING	0.788	0.735	0.024	1.883	0.368
12. DAIRY PRODUCTS	0.655	0.789	0.017	1.481	0.293
13. BREAD	0.648	0.821	0.019	1.373	0.307
14. OTHER BAKERY	0.714	0.585	0.026	1.877	0.411
15. CARBONATED BEVERAGES	0.360	0.472	0.013	1.596	0.268
16. DESSICATED COCONUT & COPRA	0.276	0.268	0.020	1.901	0.335
17. OTHER PROCESSED FOOD	0.842	0.462	0.022	1.733	0.364
18. DISTILLING	0.154	0.199	0.009	1.141	0.197
19. TOBACCO PRODUCTS	0.292	0.194	0.009	1.069	0.262
20. TEXTILES	2.054	1.124	0.039	3.105	0.864
21. WOOD PRODUCTS	1.486	0.691	0.036	3.134	0.916
22. PAPER	2.338	1.000	0.043	3.716	0.730
23. LEATHER &'c	0.656	0.439	0.018	1.885	0.364
24. RUBBER &'c	1.881	0.729	0.047	3.901	0.882
25. CHEMICALS	2.355	0.964	0.037	3.675	0.685
26. OILS & FATS	1.271	0.625	0.030	2.802	0.507
27. COCONUT FIBRE & YARN	0.423	0.397	0.024	2.470	0.460
28. PETROLEUM PRODUCTS	1.387	0.503	0.021	1.889	0.309
29. STRUCTURAL CLAY PRODUCTS	1.974	0.730	0.046	4.455	1.075
30. CERAMICS	1.427	0.737	0.031	3.201	0.872
31. CEMENT	1.803	0.738	0.010	2.796	0.495
32. BASIC METALS	1.753	0.918	0.036	2.797	0.568
33. LIGHT ENGINEERING	0.483	0.437	0.014	1.357	0.218
34. TRANSPORT EQUIPMENT	1.403	0.847	0.031	2.467	0.547
35. MACHINERY	0.765	0.460	0.017	1.517	0.267
36. OTHER MANUFACTURING	1.992	0.357	0.028	1.529	0.471
37. CONSTRUCTION	0.510	0.368	0.020	1.893	0.359
38. ELECTRICITY	6.414	1.849	0.097	9.349	1.699
39. ROAD PASSENGER TRANSPORT	3.333	1.554	0.060	4.409	1.030
40. RAIL TRANSPORT	4.054	1.453	0.083	6.653	1.445
41. WHOLESALE TRADE	0.642	0.292	0.026	2.202	0.375
42. RETAIL TRADE	0.625	0.355	0.034	2.472	0.665
43. OTHER TRANSPORT	0.632	0.348	0.026	2.266	0.454
44. COMMUNICATIONS	4.225	1.776	0.065	5.543	1.096
45. HOTELS &'c	0.693	0.422	0.033	2.589	0.697
46. PROFESSIONAL SERVICES	0.688	0.396	0.075	2.566	0.519
47. DWELLINGS	3.543	1.471	0.048	4.749	0.782
48. OTHER SERVICES	4.261	1.81			

a further 0.016 units. The capital/output ratio for tea, given in Table 30 is not therefore 1.02/1.000 but 1.02/1.016, i.e. 1.004.

As a proxy for marginal capital and import constraints, we used the 1970 actual levels of domestic savings and export revenues + net foreign transfer incomes respectively. Setting the capital constraint at 1 gave a relative import constraint of 0.9702.

Assuming these two constraints only, and the two objectives of value-added and employment, Table 31 below monitors the change in 'key sectors' as the income one would sacrifice to secure one extra job rises.

Table 31

Value Attached to 1 Job	Key Sectors Chosen	Sector Proportions
Less than 850 Rupees	Other Agriculture (8) Wholesale Trade (41)	0.744 0.256
850 to 1649 Rupees	Other Agriculture (8) Retail Trade (42)	0.688 0.312
Over 1649 Rupees	Paddy (4)	1.000

In order to maximise welfare subject to multiple constraints, the number of activities selected for a given objective function, will always be equal to, or less than, the number of constraints. In the current example, if our objective function considers the gain of 1 extra job worth the sacrifice of up to 850R of income then the optimal investment strategy involves increasing the output of 'Other Agriculture' and Wholesale Trade in the proportions 0.744 to 0.256* and from the capital-coefficients of Table 30

* There will of course be indirect expansions of other sectors, and we are not including any cross indirect stimulation the two sectors give to each other.

63.

this implies investment in the two sectors in the proportions 0.305 and
0.695 respectively.

If the value-added equivalent of one job rises to between 850R and
1649R, then a combination of .688 of Other Agriculture amd .312 of Retail
Trade is preferred; while if a job is worth the sacrifice of over 1650R
then the best strategy is based on the initial expansion of Paddy alone
(and incidentally allowing some capital to go unused - the import constraint
binding first).

Several other constraints can easily be modelled (such as
minima and maxima for the incomes of certain household groups, minimum levels
of employment, government revenue, savings and so on). One further constraint
incorporated was the 'skilled' labour one, as set out in Table 30. Again, as
a proxy for marginal scarcity, the relative supply of managerial and
professional workers was assumed limited to the 1970 numbers in work. Table
32 below gives the key sectors now selected. In each case there were surplus
unused imports.

Table 32

Value Attached to 1 Job	Key Sectors Chosen	Sector Proportions
Less than 4200 Rs.	Other Agriculture (8) Cement (31)	0.852 0.148
More than 4200 Rs.	Paddy (4) Cement (31)	0.754 0.246

Thus, Cement enters the reckoning, because, as Table 30 reveals, it has very low 'skilled' labour requirements, while still generating reasonable levels of income and employment.

12. Conclusions

The extension of our data base from 12 to 48 activities invalidates none of the conclusions reached in our earlier paper. It serves, however, to emphasise the wide variation of characteristics that exist as between activities within the economy, which cannot satisfactorily be reduced to any simple generalisations. Conflicts do arise between objectives, and there is a wide range of characteristics within 'agricultural', 'processing', 'traditional','modern' and 'service' sectors as well as between them, so necessitating disaggregated analysis.

The second part of this paper has illustrated some of the advances that can be made in isolating "efficient" activities from a disaggregated data base with many activities. A much richer range of constraints and objectives can be introduced than we have considered here. However, there comes a point where the data input becomes so extensive that a fully optimising, economy-wide model can be constructed with little further effort.

The exercises undertaken do serve to underline the lack of sophistication in many key sector/linkage studies which appear to take for granted the objective of economic expansion (gross or net output); the constraint on expansion (capital, or often none at all); and the degree of endogeneity of the model (often only direct and intermediate effects in our terminology).

Our paper exposes the complexity of the many aspects involved and raises a question mark over the ability to separate key-sector analysis from the overall economy-wide planning framework.

List of Works Cited

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