

THE INFORMATION REVOLUTION —AUSTRALIA AND THE DEVELOPING NEIGHBOURS*

by

Neil Dias Karunaratne**

ABSTRACT

This study reviews the promise of the information revolution and measures the size and the structure of the information sector prevailing in Australia and some of her developing neighbours. A methodology to identify and extract the information sector from a welter of national income and input-output statistics is discussed. The linkages, spreads and multipliers of the economies under review clearly demonstrate the importance of the industrial and service sectors. The nexus between informatisation and macro-economic development variables has been explored through a simultaneous equation model. The results further confirm the importance of the non-information sectors in the economies analysed.

The study concludes that to harness the benefits of the information revolution, planning using static linkage and multiplier criteria are counter-productive as they will reinforce the status quo. The need to create dynamic linkages, spreads and comparative advantage to foster the hyper-productive information sector is underscored. It is recommended that horizontal co-operation between Australia and her neighbours may be helpful in promoting the objective of rapid informatisation of the economies spotlighted in this study.

Key-words

Information revolution; Australia; developing economies; input-output analysis; linkages; multipliers; simultaneous equation model; planning; comparative advantage.

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** Professor, Department of Economics, University of Queensland, Brisbane, Australia.

1. The Promise of the Information Revolution

The information revolution or the increasing information intensity of economic activity has been greeted with much fanfare both by decision-makers and politicians. This increasing information intensity or informatisation holds the key to growth and development in the information era if we accept the panegyrics alluded to the process. In an information economy *par excellence* such as the United States of America nearly 50% of national income and employment is generated by information sector activities (Porat, 1977). 'Symbol manipulation' (Marschak, 1971), 'knowledge industries' (Machlup, 1963) or 'theoretically encoded knowledge' (Bell, 1973) are the pivot on which growth and development of the information economy revolves. These information intangibles have replaced energy and muscle power of the industrial economy as the main motors of growth and development in the information economy. The rapid developments in micro-electronics technology, speeding up communication and reducing transactions costs have made a decisive contribution to the informatisation of economic activity. Hitherto, the information component was a complement of other factor inputs or organisational modes in the development process. However, with the growing role of telematics (telecommunications and computers) in production and distribution the information inputs have become the engine of growth and productivity in the contemporary development process.

The information infrastructures have become the conduits through which the stimuli for productivity and development flow. In the information economy, infrastructures such as telenets and telematics are analogous to the power-grids and highways of the industrial economy. The rapid diffusion of these information infrastructures by trade, aid, investment and technology transfer mechanisms will have catalytic effects on the structure of the Australian economy and that of her developing neighbours. It has been hypothesised that the information technologies and rapid informatisation of economic activity will affect the comparative advantage or international division of labour as revealed by existing factor endowments (Kaplinsky, 1982). Further, the positive externalities or benefits generated by the new information technologies will remove some of the institutional and market clogs to improved allocative and X-efficiency. It is claimed that the new information technologies by reducing uncertainty, by removing distortions or by adding clarity to market signals will pave the way for rational decision-making (Leff, 1984) and enhanced productivity.

The emergence of the informatisation of economic activity and its associated development bonanza have been hailed as a 'second industrial revolution' (National Academy of Science, 1979). This conjures up the vision of leap-frogging into a self-sustained growth for countries like Australia and her developing neighbours trapped in

a structural malaise. Australia, having pursued inward looking policies for decades and the small neighbouring economies constrained by an underdeveloped resource base have failed to turn into NICs (Newly Industrialised Countries) by catching the magic of export led growth in the seventies. Will they now miss the boat again if they fail to take appropriate policy measures to foster information activities or the hyper-productive the information sector? Political rhetoric has incessantly underlined that countries such as Australia should awake from her slumber (Jones, 1982) and effect a restructuring of the macro-economy to capture the magic of the new information era. The central role of the new information technologies to revitalise existing industries and stimulate new growth industries in Australia has been emphasised by the Prime Minister of Australia, thus: "our location in the most dynamic forward looking part of the world imposes on our industries a need to use, develop and market new technologies aimed at niches in the world market" (Hawke, 1984). To wrest a competitive edge specialisation in a market niche, cost reduction or efficient production and product differentiation are imperative strategies (Porter, 1979). In the contemporary context, they are synonymous with informatisation or the efficient use of information technologies.

However, several conceptual and empirical snags hinder the formulation of clear cut policy guidelines to foster the informatisation process. Conceptually information is both a resource and a commodity with several peculiar characteristics. The non-appropriability and public goods characteristics associated with information production makes government investment programming in this area imperative. The leakages, free-rider and non-exclusivity characteristics or the 'invisible foot' (Hall, 1981) makes government intervention and second best policy measures in trade and development feasible. A strong case could be made for protecting information technology ventures in the 'infant industry stage' so that over time the venture could exploit scale economies, or product differentiation possibilities and compete in the world market on its own merits (Krugman, 1983).

Despite the promise of the information economy, some analysts have dismissed it as a mirage and a collective illusion that is maintained by an elitist lobby to serve their vested interests (Godet, 1984). Others have noted that these glamorous information technologies and their end products may be flops like the Concorde or the picture-phone, if they do not serve the basic needs of the people (Agrawal and Agrawal, 1984). Australia and her developing neighbours may find the technology gap between them and advanced information economies widening if they do not pursue proactive policies of informatisation. Therefore, Australia and her developing neighbours should explore the possibilities of horizontal co-operation to strengthen their bargaining position as purchasers of information technology and promoters of indigenous R&D networks (Wad, 1982).

Table 1 Sectoral Growth and Composition of the Australian Economy

Sector	1968 Value-added (A \$ billion)	%	1977 Value-added (A \$ billion)	%	AARG %
Primary	2.97	11.7	7.44	8.4	9.6
Secondary	5.98	23.6	16.25	18.5	10.5
Tertiary	12.37	48.7	42.74	48.6	13.2
Quarternary	4.06	16.0	21.59	24.5	18.4
TOTAL	25.38	100.0	88.02	100.0	

Source: For 1968, Karunaratne and Cameron, 1980.

Table 2 Rate of Growth of Teledensity (Telephones/100 persons) (1965-79)

Country	Teledensity (1965)	Teledensity (1979)	AARG (%)
Australia	24.70	46.40	1.04
Indonesia	1.36	0.30	1.04
Malaysia	1.37	3.17	20.01
Philippines	0.39	1.34	26.80
Singapore	4.60	23.80	28.71
Thailand	0.25	0.98	32.81

Source: Macdonald and Mandeville, 1984.

Available evidence indicates that the information sector in Australia is the fastest growing sector in the macro-economy. It grew at the rate of 18.4% per annum, while the primary sector increased only at 9.6% per annum during 1968-77 (see Table 1). Although, comparable data are not available for Australia's neighbouring economies, proxy indicators such as tele-density reveal that ASEAN neighbours are rapidly building their information infrastructures. The tele-density grew at rates above 20% per annum for most ASEAN economies during 1965-75 (See Table 2). On the basis of available evidence the information economy or sector is fast growing in the countries that are being reviewed in this study.

To examine the pros and cons of informatisation strategies it is desirable to have insights about the magnitude and structure of the information sector or information activities in Australia and her developing neighbours. With this objective in mind a methodology to identify and measure the size of the information sector and its structure has been devised and the results of its empirical validation are reviewed in the next section.

2. Identification and measurement of the information sector

The importance of the information economy or sector as perceived from growth and

development angles dictates its measurement and structural analysis as an aid to policy formulation. Available national income and input-output statistics are impervious to the importance of the information economy as they have been designed to address macro-economic stabilisation and growth problems of a fading industrial age. Although the data bases are admirably suited to study the structural transformation from a predominantly agrarian to a post-industrial society, they provide no insights on the magnitude or the inter-links of the information sector with the macro-economy.

A non-survey method to tease out the information sector by using secondary data from census and sample surveys has been devised (Karunaratne, 1983a, 1983b). This methodology identifies using an OECD classification (OECD, 1981) and supplementary country records the information activities that are embodied in each conventional sector of an input-output table. These information activities are systematically separated and re-assembled as information sectors showing their interrelationship to the conventional sectors.

The information sector in this study is defined as the quarternary sector and covers only marketed or the primary information goods and services. The quarternary or primary information sector is the hub of the growing information economy. There also exist secondary or non-market information activities which have been glossed over in this study. The secondary information activities emanate from the in-house transactions of the private and public sector bureaucracies or the technostucture (Galbraith, 1967).

The output of the quarternary or the primary information sector consists of commodities that intrinsically convey information or are used for distribution of information through the market.

An inter-industry transaction in an input-output table may have embedded in it an information component. The goods and services that comprise the transaction can be identified as informational or non-informational using the OECD classification of information commodities (OECD, 1981). Using country specific census and survey data values could be imputed to information transactions thus determining their relative importance in each sector's gross output. The dichotomisation of sectoral transactions to non-information results in a four-way partitioning of each transaction, preserving the dictates of input-output logic thus:

Pre-Dichotomisation	Post-Dichotomisation	
(Original transaction) =	Non-information into	Non-information into
	Non-information	Information
	Information into	Information into
	Non-information	Information

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$$\begin{array}{lcl}
 \text{Pre-Dichotomisation} & & \text{Post-Dichotomisation} \\
 & & \left[\begin{array}{cc}
 \begin{array}{c} \text{Non-information} \\ \text{into} \\ \text{Non-information} \end{array} & \begin{array}{c} \text{Non-information} \\ \text{into} \\ \text{Information} \end{array} \\
 \hline
 \begin{array}{c} \text{Information} \\ \text{into} \\ \text{Non-information} \end{array} & \begin{array}{c} \text{Information} \\ \text{into} \\ \text{Information} \end{array}
 \end{array} \right] \\
 (\text{Original transaction}) = & &
 \end{array}$$

All similar components are re-arranged clearly distinguishing non-information, cross transactions, and information transactions. Thereafter, the detailed sectoral picture of the macro-economy could be re-aggregated and condensed to any level desired. In this study for all economies reviewed, a highly aggregated four sector economy was generated, with agriculture (primary), manufacturing (secondary) and services (tertiary) as the three non-information sectors. The information sector was the fourth (quarternary) sector. The four-sector Input-Output Tables, identifying the information sector compiled for Australia, ASEAN and some Pacific neighbours, are reported in Appendix A.

A comparative study of macro-economic magnitudes such as value-added, final demand and output reveal that Australia and her neighbouring economies under review are predominantly service or industrial in character. The top ranking modal sector was the service sector followed by manufacturing (see Table 3). Australia was also a pre-eminent service economy with the service sector generating 49% of the total value-added, 61% of the total final demand and 41% of the total output. The comparable figures for the Australian information sectors are 25%, 16% and 19% of the total value-added, final demand and output, respectively (see Appendix B). In the cross-country sample of economies reviewed the information sector frequently ranked a notch above the bottom ranking agriculture sector. The economies under focus were low in information intensity, and clearly a long way off from the promised land of the information era.

Table 3 Macro-economic Magnitude (Sectoral Rankings)

Macro Criterion	Value-Added (Ranking)	Final Demand (Ranking)	Output (Ranking)
Australia	(4) (3) (1) (2)	(4) (2) (1) (3)	(4) (2) (1) (3)
Fiji	(2) (4) (1) (3)	(4) (2) (1) (3)	(3) (2) (1) (4)
New Zealand	(4) (2) (1) (3)	(4) (2) (1) (3)	(4) (2) (1) (3)
Papua New Guinea	(1) (4) (2) (3)	(1) (3) (2) (4)	(2) (3) (1) (4)
Indonesia	(1) (4) (2) (3)	(2) (3) (1) (4)	(1) (3) (2) (4)
Malaysia	(3) (2) (1) (4)	(4) (1) (2) (3)	(3) (1) (2) (4)
Philippines	(2) (3) (1) (4)	(4) (2) (1) (3)	(3) (1) (2) (4)
Singapore	(4) (2) (1) (3)	(4) (2) (1) (3)	(4) (2) (1) (3)
Thailand	(2) (3) (1) (4)	(4) (2) (1) (3)	(3) (1) (2) (4)
Mode	(4) (3) (1) (3) or (4)	(4) (2) (1) (3)	(3) (2) (1) (4)

Source : Appendix B.

Sector Code : 1 Primary or Agriculture
 2 Secondary or Manufacturing
 3 Tertiary or Service
 4 Quarternary or Information

3. Structural analysis using linkages and multipliers

The structure of the macro-economy can be probed for productivity prospects at sector level using linkage and multiplier criteria. These criteria are based on sectoral interdependencies prevalent in a given macro-economy as captured by the statical Leontief input-output snap-shot. The backward linkages show on the basis of potential bottlenecks in intermediate input demands, the attractiveness of sectors from a growth perspective. The forward linkages show how an excess supply of intermediate inputs can provide inducements to establish industries based on excess supply conditions. These input shortages due to excess demand or input over-supply trigger unbalanced growth in the context of an endemic shortage of investible resources in developing economies (Hirschman, 1958). In the economies under review, the sector that qualifies for special treatment on the basis of backward linkage is the manufacturing sector. This is the top-ranking modal sector. In the case of forward linkage, the top-most modal sector is the service sector for the sample of countries under study. Australia's top ranking sector for backward linkage was the manufacturing sector, showing a compatibility with the modal rankings of the neighbouring economies (see Table 4).

The spread indices monitor the potential for maximal diversification due to sectoral expansion and have an affinity with balanced growth strategies (Myrdal, 1957). For the cross-country sample of economies the first position was earned by manufacturing on the basis of both the backward and forward spread indices. In the case of Austral-

Table 4 Linkage and Spread Effects

Country \ Criterion	Backward Linkage (Ranking)				Forward Linkage (Ranking)				Backward Spread (Ranking)				Forward Spread (Ranking)			
Sector Code	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1 Australia	(3)	(1)	(2)	(4)	(4)	(1)	(3)	(2)	(1)	(3)	(2)	(4)	(4)	(1)	(2)	(3)
2 Fiji	(4)	(1)	(2)	(3)	(2)	(3)	(1)	(4)	(2)	(1)	(4)	(3)	(1)	(3)	(2)	(4)
3 Papua New Guinea	(4)	(2)	(1)	(3)	(4)	(2)	(1)	(3)	(3)	(1)	(4)	(2)	(1)	(3)	(4)	(2)
4 New Zealand	(2)	(1)	(3)	(4)	(3)	(2)	(1)	(4)	(2)	(1)	(4)	(3)	(3)	(2)	(1)	(4)
5 Indonesia	(4)	(1)	(2)	(3)	(1)	(2)	(3)	(4)	(1)	(4)	(3)	(2)	(4)	(3)	(2)	(1)
6 Malaysia	(4)	(1)	(2)	(3)	(4)	(2)	(1)	(3)	(4)	(2)	(1)	(3)	(2)	(1)	(3)	(4)
7 Philippines	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(1)	(2)	(3)	(4)
8 Thailand	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(2)	(1)	(3)	(4)
9 Singapore	(4)	(2)	(1)	(3)	(4)	(3)	(1)	(2)	(4)	(3)	(1)	(2)	(2)	(1)	(4)	(3)
Mode	(4)	(1)	(2)	(3)	(4)	(2)	(1)	(3)	(4)	(1)	(2)	(3)	(1)	(1)	(2)	(4)
											and (4)		and (2)		and (3)	

Source : Appendix C ; Appendix D for Methodology of linkages and spreads.

Table 5 Multiplier Analysis

Country \ Criterion	Output Multiplier (Ranking)	Income Multiplier -Type IA (Ranking)	Income Multiplier -Type IB (Ranking)	Income Multiplier -Type IIA (Ranking)	Income Multiplier -Type IIB (Ranking)
Sector Code	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
Australia	(4) (3) (1) (2)	(4) (3) (1) (2)	(2) (1) (3) (4)	(2) (1) (3) (4)	(2) (1) (3) (4)
Fiji	(4) (3) (1) (2)	(3) (1) (2) (4)	(3) (1) (2) (4)	(3) (1) (2) (4)	(3) (1) (2) (4)
New Zealand	(4) (2) (3) (1)	(1) (2) (3) (4)	(1) (2) (3) (4)	(1) (2) (3) (4)	(1) (2) (3) (4)
Papua New Guinea	(4) (3) (1) (2)	(2) (1) (3) (4)	(2) (1) (3) (4)	(2) (1) (3) (4)	(2) (1) (3) (4)
Indonesia	(4) (2) (1) (3)	(2) (1) (3) (4)	(2) (1) (3) (4)	(2) (1) (3) (4)	(4) (1) (3) (2)
Malaysia	(4) (3) (1) (2)	(2) (1) (3) (4)	(2) (1) (4) (3)	(4) (1) (3) (2)	(2) (1) (4) (3)
Philippines	(4) (2) (1) (3)	(4) (1) (3) (2)	(4) (1) (3) (2)	(4) (1) (3) (2)	(4) (1) (3) (2)
Singapore	(4) (3) (1) (2)	(2) (1) (4) (3)	(2) (1) (4) (3)	(2) (1) (4) (3)	(2) (1) (4) (3)
Thailand	(4) (2) (1) (3)	(4) (2) (1) (3)	(2) (1) (3) (4)	(2) (1) (3) (4)	(2) (1) (3) (4)
Mode	(4) (3) (1) (2)	(2) (1) (3) (4)	(2) (1) (3) (4)	(2) (1) (3) (4)	(2) (1) (3) (4)

Sources: Appendix C; Appendix D gives definitions of multipliers.

ia, the agricultural sector qualified as the top most sector with forward spread effects. Overall, for Australia and her neighbours, the linkages and spread criteria did not accord the information sector a star billing. On the contrary, often it was relegated to a slot just above the bottom ranking agricultural sector (see Table 4).

Several multipliers covering output and income were calculated to gain further insights about the nature of the information sector. Various income multipliers, excluding and endogenising the household sector, were calculated. The service and the information sectors ranked first and second modal sectors from the standpoint of output multipliers for the sample of economies under study. Australia's output multiplier rankings were consistent with the modal rankings of her neighbours. The modal sectoral ranking from the standpoint of income multipliers were manufacturing and agriculture in that order of importance. Australia's sectoral ranking for income multipliers was compatible with the modal rankings for her neighbours (see Table 5).

The linkages indicate the attractiveness of sectors for development if marginal changes are effected by allocating resources to sectors with high linkage sectors. The multipliers, on the other hand, demonstrate the responsiveness of sectors on the basis of output or income criteria as a result of exogenous changes. Both linkage and multiplier criteria are basically static measures that sort out the growth potential of a given economic structure as captured by the Leontief input-output tables. In the predominantly non-information economic structures prevailing in Australia and her neighbouring economies therefore, it is not surprising that the information sector did not emerge as a sector with much development potential. The analysis highlights the danger of using static criteria based on existing economic structures to programme for the

harnessing of the productivity of a sector that is still emerging. The use of these linkage and multiplier criteria for policy formulations to usher the information revolution in Australia and her neighbours would be, therefore, quite misleading.

4. The conceptualisation of the informatisation-development nexus

The disappointing results yielded by sector programming criteria (linkages and multipliers) for examining the structure and nature of informatisation lead us to briefly review whether any mileage could be gained by the neo-classical aggregate production function for planning purposes. The main contribution of this section, however, is the conceptualisation of the inter-relationship or the nexus that prevails between informatisation and macro-economic variables. Such modelling will provide insights into the complex structure and nature of the inter-actions between informatisation and development in Australia and her neighbouring economies.

The neo-classical model that attempts to measure the contribution of the information sector to growth is plagued by several deficiencies. First, the contribution of the information sector to growth is derived in a residual manner after accounting for the weighted growth rates of factor inputs. This neutrino or residual is an amalgam of stochastic error and total factor productivity and has been labelled as 'technical progress' (Solow, 1957), 'advances in knowledge' (Denison, 1981), 'total factor productivity' (Kendrick and Grossman, 1980), and we refer to it here as the contribution of the information sector. The residual or tail is the parameter that signifies a shift in the neo-classical production function. It has become so large that it has been observed that the tail now wags the neo-classical dog to cast doubts about the validity of the neo-classical paradigm (Winter and Nelson, 1982:205). Secondly, it is alleged that the neo-classical paradigm with its rigid foundation of competitive equilibrium mechanics is inappropriate to capture the disequilibria that characterise the development process (Chenery, 1983:857). Thirdly, the meagre empirical research that has explored the nexus between value-added and investment in information sector using Cobb-Douglas production functions (Hayes and Erickson, 1982) or the two-sector models analysing growth and investment in information technology (Jonscher, 1983) have been partial equilibrium approaches. Moreover, they posit a one-way causal relationship between information sector and growth. However, many macro-economic policy reports have perceived the two-way relationship that prevails between growth and the informatisation of the economy (Nora-Minc 1978, Clyne 1978, MITI, 1980).

There is an unequivocal case to conceptualise a model that will overcome some of the limitations of the neo-classical paradigm. The magnitude of the information sector can be measured directly as described by the methodology in Section 2 of this study. The disequilibria and interactions that occur in the development process can be con-

ceptualised by an eclectic simultaneous equation model:

$$G_i = f(Y_i, Q_i, T_i) \dots\dots\dots \text{I}$$

$$Q_i = f(G_i, S_i, D_i) \dots\dots\dots \text{II}$$

$$S_i = f(Q_i, T_i, X_i) \dots\dots\dots \text{III}$$

$$T_i = f(Q_i, P_i, \pi_i) \dots\dots\dots \text{IV}$$

where subscript: i = i th country or macro-economy;

and endogenous variables: G_i = Growth rate of per capita GNP.

Q_i = Size of the information sector as % of GNP or informatisation.

S_i = Size of the manufacturing sector as % of GNP or industrialisation.

T_i = Trade performance indicator or exports as % of total trade (exports plus imports); and

pre-determined variables: Y_i = Per capita GNP.

D_i = Tele-density or telephones/100 people.

X_i = Rate of growth of exports

P_i = Unit export price index

π_i = Rate of growth of inflation.

It could be hypothesised as in equation I, that rate of growth of the macro-economy (G), depends on the prevailing institutional modes and market orientation proxied by per capita income (Y), the size of the information sector (Q) and the country's trade performance or revealed comparative advantage as depicted by (T). The sample of economies under scrutiny in this particular case are constrained by an institutional malaise, small information sectors and poor trade performance. Hence *a priori*, we cannot expect a strong nexus between growth and the explanatory variables in this equation.

Equation II of the model endogenises the information sector (Q) and explicates it by growth (G), the magnitude of the manufacturing sector (S), and the importance of telematics as shown by the surrogate tele-density (D). A priori we could anticipate that growth and telematics will contribute significantly to informatisation, whilst manufacturing will decrease as informatisation accelerates due to macroeconomic restructuring. Equation I and II also depicts the simultaneous interaction between growth and informatisation and vice versa-a phenomenon ignored in the neo-classical single-equation approach.

In equation III, we postulate that the size of the manufacturing sector (S) depends on the size of the information sector (Q), trade performance (T) and the rate of growth of exports. The radiant dynamics of the manufacturing sector in the economies covered by the sample will be explained by arguments such as informatisation and growth of exports. Poor trade performance may hinder the manufacturing sector, whilst a healthy

trade performance may give it a shot in the arm.

The trade performance indicator (T) depicted in equation IV is explained by informatisation (Q), the international competitiveness proxied by export price index (P) and domestic cost structures represented by the surrogate:inflation rate (π). *A priori* the poor trade performance captured in the trade performance indicator (T) may be inversely related to informatisation, competitiveness and directly related to domestic cost structures.

The above 4 equation model which describes the interaction between informatisation and crucial aspects of macro-economic development comprise of nine (9) variables, four (4) of which are endogenous and the remaining five (5) are predetermined variables. The identification rules decree that all equations are over-identified. The simultaneity bias that prevails in the model equations can be rectified by estimating the model

Table 6 Sample Data Base for Simultaneous Equation Modelling

Macro-Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Country	G_i	Y_i	Q_i	S_i	T_i	X_i	P_i	π_i	D_i
Australia	2.8	5641	25	18	47	1.8	66.8	11.7	52.6
Fiji	6.0	915	17	11	45	1.7	73.0	7.8	7.3
New Zeland	1.9	1932	19	20	61	2.6	54.6	12.3	56.8
Papua New Guinea	2.8	375	11	11	62	1.6	43.4	9.5	1.6
Indonesia	4.1	244	9	11	56	2.4	40.9	20.3	0.3
Malaysia	4.0	683	16	25	47	3.1	58.7	7.3	4.4
Philippines	2.6	374	13	18	38	2.2	78.4	13.3	1.1
Singapore	7.4	2153	24	32	43	3.2	62.0	5.5	35.0
Thailand	4.6	408	10	20	41	3.9	66.2	9.5	1.1

Explanatory notes on model variables:

G_i : Per capita growth rate of GNP (%) (1960-79).

Source: World Development Report 1981, The World Bank.

Y_i : Value-added or Income per capita (1975) in US\$.

Source: Input-output tables used in the study.

Q_i : Value-added or Income (1975) generated by the quarternary sector.

Source: Input-output tables used in the study.

S_i : Value-added or Income (1975) generated by the secondary sector.

Source: Input-output tables used in the study.

T_i : $T_i = \frac{X_i}{X_i + M_i}$

where X_i = Value of exports and M_i = Value of imports (1975).

Source: Input-output tables used in the study.

X_i : Average annual rate of growth of exports (%) (1975-1980).

Source: IMF, *Financial Statistics*, Yearbook, 1983.

P_i : Unit price of exports (1975).

Source: IMF, *Financial Statistics*, Yearbook, 1983.

π_i : Rate of inflation or AAGR of CPI (1970-1978).

Source: IMF, *Financial Statistics*, Yearbook, 1983.

D_i : Tele-density or telephones per 100 persons.

Source: AT&I, *The World Telephones*, 1980, 1981, 1982.

Table 7 Regression Results of 2SLS Estimation of the Model

LINEAR VERSION										
Equation	Pre-determined Endogenous Variable	Constant	G	Q	S	T	Y	X	π	P
I	G	5.02 (0.87)		(0.17) (0.63)			-0.0006 (-0.69)			
II	Q	1.63 (0.34)	4.83 (2.23)*		-0.59 (-1.54)					0.33 (4.11)*
III	S	-9.04 (-0.59)		0.68 (2.29)*		0.002 (0.011)		6.59 (2.90)*		
IV	T	7.25 (5.45)*		0.43 (1.09)					0.22 (0.44)	-0.62 (-3.78)*
LOG VERSION										
Equation	Pre-determined Endogenous Variable	Constant	G	Q	S	T	Y	X	π	P
I	G	4.36 (0.91)		0.99 (0.47)		-0.86 (-0.79)	-0.36 (-0.49)			
II	Q	2.45 (5.42)*	0.20 (1.56)		-0.11 (0.56)					0.20 (5.92)*
III	S	1.00 (0.50)		0.59 (3.00)*		-0.14 (0.32)		0.92 (3.77)*		
IV	T	6.22 (8.16)*		0.20 (1.85)					0.09 (0.86)	-0.76 (4.57)*
Statistics										
S = 2.04 R ² = 0.18 F = 0.36										
S = 2.84 R ² = 0.85 F = 9.69*										
S = 4.59 R ² = 0.73 F = 4.63										
S = 5.29 R ² = 0.77 F = 5.57*										
S = 0.49 R ² = 0.20 F = 0.43										
S = 0.14 R ² = 0.92 F = 18.0*										
S = 0.20 R ² = 0.83 F = 8.35*										
S = 0.09 R ² = 0.83 F = 8.01*										

Notes: (t-statistic in parenthesis); * Significant at 5% level; # Significant at 1% level.

parameters by the two-stage least squares (2SLS) technique. The empirical basis and the results of validation of the model are shown in Table 6 and 7 respectively. A linear and log version of the model have been fitted, the latter version has the advantage of yielding elasticity interpretations for estimates of the regression coefficients.

5. Empirical validation of the informatisation-development model

The sample results for the growth function (Equation I) gave a disappointing fit. The institutional modes, informatisation, poor trade performance were not significant explanatory variables. Together they explained only 18% of the overall variation in growth and proved to be jointly non-significant. The results corroborate that institutional modes, the low status of the information sector and trade performance constrain growth by not contributing to it in a manner discernible in advanced information economies.

The information function (Equation II) was significantly and positively explained by growth and telematic activity. Industrialisation although not significant, as expected, showed a negative bearing on informatisation.

The explanatory variables were jointly significant and explained nearly 85% of the variation of the information sector.

The size of the manufacturing sector (Equation III) was explained in a significant manner by the contribution of informatisation and rate of growth of exports. The prevailing comparative advantage or trade performance indicator hardly made any impact on industrialisation. Jointly the explanatory variables explained 73% of the variation in industrialisation. One could suspect that multi-collinearity as the culprit that renders trade performance effects on growth insignificant.

Trade performance (Equation IV) was not related to informatisation in a significant manner, the poor performance simulated by the variable was positively related to inflation, albeit insignificantly. It was negatively and significantly related to international competitiveness which has been proxied by unit export price indices. Jointly the variables explain nearly 77% of the variation in trade performance (see Table 7).

The log-version of the empirical results broadly support the conclusions derived from the linearised version above (see Table 7). The results based on a small cross-country sample are not definitive. They are, nevertheless, indicative of the need for more theoretical and empirical research on the complex process that links informatisation and development. Such research is imperative to provide meaningful insights to policy-makers who formulate goals and strategies for long-term macro-economic development.

6. Concluding Observations

There has been much canvassing of the benefits of the information revolution both in Australia and her developing neighbours. This study has attempted to review the promise of the information revolution against the back-drop of the structure and magnitude of informatisation prevalent in a sample of neighbouring macro-economies. The linkage, spread and multiplier criteria clearly revealed that non-information sectors, such as service and manufacturing, were the most attractive for development given the make-up of these economies. Even the inter-relationships prevailing in the economies between informatisation and macro-economic variables hint that the information and development nexus was shaky and imperceptible.

The empirical insights gained by applying static main-stream planning criteria, although disappointing to the pushers of rapid informatisation panceas, are not surprising given the fact that the economies under the spotlight are basically industrial or service in character. The linkages and multipliers indicate that in promoting short-term maximal growth, industrial and service sectors of the economy will be the favoured candidates, if the *status quo* is to be preserved.

However, informatisation of Australia and her developing neighbours pre-supposes massive structural changes and an ushering in a new economic ethos based on information rather than industrial raw materials and energy. Therefore, the guidelines for growth and development proffered by static marginal criteria are mis-directed. New dynamic linkages, spreads and comparative advantage have to be created. These dynamic linkages, although latent in the economies under scrutiny have yet to surface. Information economies such as Japan ushered the information era by rejecting the guidelines given by static mainstream paradigms (Scott, 1984). The same message is valid for Australia and her neighbours if the aim is to harness the rewards of informatisation for rapid growth and development.

The attempt to detect signals and devise blue-prints to implement a rapid informatisation strategy by analysing empirical data bases and inter-connections existing in pre-information economies may be a futile exercise. It may be as counter-productive as the blind man's attempts to look for a black cat in a dark room that is not there. Nevertheless, both in Australia and her neighbouring economies, those who call the shots or decision-makers persist with obsolete techniques and myths trying to foster the information economy using industrial criteria (Lamberton, 1984).

The way to informatise is to create or innovate dynamic linkages, multipliers and comparative advantage. A range of interventionist and market oriented policies may have to be evolved to foster dynamic linkages and dynamic comparative advantage. The rapid diffusion of the new information order will see that Australia and her neigh-

bours collectively falling behind their competitors, if timely policies for the informatisation of their economies are not evolved. In the past the pursuit of neo-protectionist policies have generated much trade friction between Australia and her ASEAN neighbours with heavy economic and foreign policy costs to all parties (Garnaut and Anderson, 1980). The promise of the information revolution can be harvested by eschewing the narrow nationalistic policies of the past and adopting instead, policies for horizontal co-operation to identify and promote projects in the emergent information sector in Australia and the neighbouring countries.

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Appendix A

AUSTRALIA (1977-78) (A \$ BILLIONS)

SECTOR	1	2	3	4	H-H	O.F.D. EXPORTS	TOTAL	
1	1	7	1	0	1	0	5	13
2	2	16	10	2	15	6	5	57
3	1	4	8	2	29	23	3	71
4	1	3	8	5	7	8	1	33
H-H	2	10	25	14	0	0	0	51
O.V.A.	6	6	18	7	4	0	0	41
IMPORTS	1	10	1	2	1	0	1	16
TOTAL	13	57	71	33	57	37	14	0

FIJI (1977) (\$ F MILLIONS)

SECTOR	1	2	3	4	H-H	O.F.D. EXPORTS	TOTAL	
1	3	93	5	0	67	10	9	187
2	2	13	33	4	108	22	118	300
3	20	13	71	14	188	139	30	476
4	4	4	21	4	62	36	12	144
H-H	71	33	191	68	1	0	0	364
O.V.A.	64	33	101	31	0	0	0	230
IMPORTS	23	110	53	21	85	53	34	380
TOTAL	187	300	476	144	511	260	204	0

NEW ZEALAND ECONOMY 1972. (NZ \$ MILLIONS)

SECTOR	1	2	3	4	H-H	O.F.D. EXPORTS	TOTAL	
1	254	808	17	8	100	130	223	1540
2	158	616	536	108	1159	391	917	3885
3	147	428	1007	218	1955	1402	322	5479
4	63	124	433	195	493	514	34	1855
H-H	180	792	1781	830	0	0	26	3609
O.V.A.	685	563	1448	417	230	25	10	3378
IMPORTS	54	553	257	80	358	228	29	1560
TOTAL	1540	3885	5479	1855	4294	2690	1562	0

PAPUA NEW GUINEA (1976/77) (MILLIONS OF KINA)

SECTOR	1	2	3	4	H-H	O.F.D. EXPORTS	TOTAL	
1	2	24	11	0	272	20	457	785
2	28	14	77	7	150	6	31	313
3	62	70	232	27	158	397	38	984
4	9	13	56	9	18	114	4	222
H-H	73	43	329	111	0	0	0	556
O.V.A.	515	99	130	40	1	0	17	802
IMPORTS	97	52	148	29	177	44	1	548
TOTAL	785	313	984	222	776	581	549	0

Appendix A continued

INDONESIA 1975 (BILLIONS OF RUPIAH)

SECTOR	1	2	3	4	H-H	O.F.D. EXPORTS	TOTAL	
1	1094	1604	323	29	2466	50	2710	8276
2	220	1081	1150	155	2938	926	250	6720
3	204	443	679	188	2364	2861	359	7099
4	87	147	312	107	814	539	27	2033
H-H	831	466	1700	412	0	0	0	3408
O. V. A.	5715	993	2777	801	0	0	0	10286
IMPORTS	127	1986	158	342	0	0	0	2612

MALAYSIA (1975) (MILLIONS M\$)

SECTOR	1	2	3	4	H-H	O.F.D. EXPORTS		TOTAL
1	0	5	0	0	1	0	0	7
2	1	3	2	1	5	2	7	20
3	0	1	1	0	4	4	1	11
4	0	0	1	1	2	2	1	6
H-H	1	1	3	2	0	0	0	7
O.V.A.	4	4	4	2	0	0	0	13
IMPORTS	2	5	1	2	0	0	0	10
TOTAL	7	20	11	6	13	8	9	0

PHILLIPINES (1975) (MILLIONS OF PESOS)

SECTOR	1	2	3	4	H-H	O.F.D. EXPORTS	TOTAL	
1	2	27	1	0	11	2	6	51
2	4	21	12	2	37	16	10	103
3	1	8	7	2	24	24	3	70
4	1	2	4	2	10	4	1	23
H-H	12	5	18	4	0	0	0	39
O.V.A.	23	16	26	10	0	0	0	75
IMPORTS	9	23	1	1	0	0	0	34
TOTAL	51	103	70	23	82	46	20	0

SINGAPORE (1975) (S\$ MILLIONS)

SECTOR	1	2	3	4	H-H	O.F.D. EXPORTS	TOTAL	
1	39	5038	234	31	438	133	66	5978
2	459	5300	3186	1382	4427	4336	6628	25718
3	91	1197	869	436	2549	2849	2848	10838
4	18	667	1033	1121	824	1681	2683	8028
H-H	343	4241	5453	3108	0	0	0	13145
O.V.A.	0	0	0	0	0	0	0	0
IMPORTS	5029	9276	62	1951	0	0	0	16318
TOTAL	5978	25718	10837	8028	8239	9000	12225	0

Appendix A continued

THAILAND (1975) (BILLIONS OF BAHT)

SECTOR	1	2	3	4	H-H	O.F.D.	EXPORTS	TOTAL
1	6	71	4	0	35	4	7	128
2	13	60	43	5	103	36	32	292
3	4	22	24	5	100	62	14	230
4	1	5	7	2	18	15	2	51
H-H	9	20	52	14	0	0	0	96
O.V.A.	80	56	96	20	0	0	0	253
IMPORTS	15	57	4	3	0	0	0	79
TOTAL	128	292	230	51	256	117	55	0

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Appendix B: Macro-economic Magnitudes

Country	Sector	Value-added	%	(Rank)	Final Demand	%	(Rank)	Output	%	(Rank)
AUSTRALIA (1977-78) (A \$ billion)	1	7.44	8.4	(4)	4.24	4.8	(4)	13.40	7.7	(4)
	2	16.25	18.5	(3)	16.40	18.7	(2)	56.65	32.3	(2)
	3	42.74	48.6	(1)	53.20	60.7	(1)	40.96	40.8	(1)
	4	21.59	24.5	(2)	13.78	15.7	(3)	32.97	19.2	(3)
Total		88.02	100.0		87.62	100.0		174.00	100.0	
FIJI (1977) (F \$ million)	1	137.49	22.7	(2)	62.61	10.5	(4)	187.04	16.9	(3)
	2	66.96	11.3	(4)	137.56	23.2	(2)	300.16	27.1	(2)
	3	292.54	49.3	(1)	303.98	51.2	(1)	476.48	43.0	(1)
	4	99.23	16.7	(3)	89.36	15.1	(3)	143.94	13.0	(4)
Total		593.52	100.0		593.51	100.0		1107.62	100.0	
NEW ZEALAND (1972) (NZ \$ million)	1	864.8	12.9	(4)	399.3	6.0	(4)	1540.4	12.1	(4)
	2	1354.6	20.2	(2)	1914.3	28.6	(2)	3885.0	30.4	(2)
	3	3229.2	48.2	(1)	3421.7	51.1	(1)	5478.9	42.9	(1)
	4	1247.1	18.6	(3)	960.3	14.3	(3)	1855.1	14.5	(3)
Total		6695.8	100.0		6695.5	100.0		12759.4	100.0	
PAPUA NEW GUINEA (1976-77) (Kina million)	1	588.05	43.9	(1)	652.25	48.0	(1)	785.31	34.1	(2)
	2	147.78	10.6	(4)	135.36	9.8	(3)	313.27	13.6	(3)
	3	459.87	34.3	(2)	444.63	32.7	(2)	983.93	42.7	(1)
	4	150.28	11.2	(3)	127.71	9.4	(4)	222.38	9.6	(4)
Total		1339.98	100.0		1359.95	100.0		2304.89	100.0	
INDONESIA (1975) (Rupiah billion)	1	6545.0	47.8	(1)	5099.9	37.3	(2)	8276.0	7.7	(1)
	2	1459.0	10.6	(4)	2128.2	15.5	(3)	6720.1	32.3	(3)
	3	4477.3	32.7	(2)	5427.3	39.6	(1)	7099.0	40.8	(2)
	4	1212.9	8.9	(3)	1038.7	7.6	(4)	2033.1	19.2	(4)
Total		13695.1	100.0		13694.1	100.0		24128.2	100.0	
MALAYSIA (1975) (M \$ million)	1	4.55	23.2	(3)	0.1	0.5	(4)	7.14	15.9	(3)
	2	4.91	25.1	(2)	8.42	43.0	(1)	20.18	44.9	(1)
	3	7.00	35.7	(1)	8.18	41.8	(2)	11.22	24.9	(2)
	4	3.13	16.0	(4)	2.87	14.7	(3)	6.41	14.3	(4)
Total		19.59	100.0		19.57	100.0		44.95	100.0	

Appendix B : continued

Country	Sector	Value-added	%	(Rank)	Final Demand	%	(Rank)	Output	%	(Rank)
PHILIPPINES (1975) (Pesos million)	1	34.11	29.8	(2)	11.25	9.8	(4)	51.37	20.71	(3)
	2	21.24	18.6	(3)	40.20	35.2	(2)	102.99	41.6	(1)
	3	44.49	38.8	(1)	50.37	44.1	(1)	70.16	28.3	(2)
	4	14.71	12.8	(4)	12.41	10.9	(3)	23.15	9.4	(4)
Total		114.55	100.0		114.23	100.0		247.77	100.0	
SINGAPORE (1975) (S \$ million)	1	343.0	2.6	(4)	-4392.3	-33.4	(4)	5978.4	11.8	(4)
	2	4240.5	32.3	(2)	6114.8	46.5	(2)	25718.0	50.9	(2)
	3	5453.4	41.5	(1)	8183.4	62.3	(1)	10837.4	21.4	(1)
	4	3108.0	23.6	(3)	3238.1	24.6	(3)	8027.8	15.9	(3)
Total		13144.9	100.0		13143.7	100.0		50561.6	100.0	
THAILAND (1975) (Baht million)	1	89.48	25.7	(2)	31.13	8.9	(4)	128.01	18.3	(3)
	2	76.57	22.0	(3)	113.79	32.7	(2)	291.59	41.6	(1)
	3	147.83	42.4	(1)	171.67	49.3	(1)	51.19	7.3	(4)
	4	34.59	9.9	(4)	31.86	9.1	(3)	51.19	7.3	(4)
Total		348.47	100.0		348.45	100.0		701.14	100.0	

Appendix C : Linkages and Spread Criteria

Sector	Country	L,B	(Rank)	L,F	(Rank)	S,B	(Rank)	S,F	(Rank)
1	AUSTRALIA	0.97	(3)	0.80	(4)	0.86	(1)	1.14	(4)
2		1.67	(1)	1.26	(1)	1.03	(3)	0.91	(1)
3		0.99	(2)	0.96	(3)	0.95	(2)	0.96	(2)
4		0.88	(4)	0.98	(2)	1.15	(4)	0.97	(3)
1	FIJI	0.91	(4)	1.06	(2)	1.05	(2)	0.87	(1)
2		1.14	(1)	0.91	(3)	0.82	(1)	1.09	(3)
3		1.04	(2)	1.17	(1)	1.08	(4)	0.90	(2)
4		0.92	(3)	0.86	(4)	1.05	(3)	1.14	(4)
1	NEW ZEALAND	1.02	(2)	0.99	(3)	0.98	(2)	1.05	(3)
2		1.13	(1)	1.03	(2)	0.86	(1)	0.98	(2)
3		0.97	(3)	1.12	(1)	1.09	(4)	0.87	(1)
4		0.88	(4)	0.85	(4)	1.07	(3)	1.06	(4)
1	PAPUA NEW GUINEA	0.85	(4)	0.80	(4)	1.06	(3)	0.80	(1)
2		1.11	(2)	0.92	(2)	0.82	(1)	0.92	(3)
3		1.22	(1)	1.42	(1)	1.09	(4)	1.42	(4)
4		0.92	(3)	0.87	(3)	1.02	(2)	0.87	(2)
1	INDONESIA	0.86	(4)	1.15	(1)	1.24	(1)	0.83	(4)
2		1.16	(1)	1.10	(2)	0.88	(4)	0.93	(3)
3		1.05	(2)	0.95	(3)	0.90	(3)	1.03	(2)
4		0.93	(3)	0.80	(4)	0.98	(2)	1.20	(1)
1	MALAYSIA	0.86	(4)	1.04	(2)	1.11	(4)	0.86	(2)
2		1.17	(1)	1.22	(1)	0.93	(2)	0.85	(1)
3		1.01	(2)	1.22	(1)	0.93	(2)	0.85	(1)
4		0.96	(3)	0.88	(3)	1.03	(3)	1.16	(4)
1	PHILIPPINES	0.81	(4)	1.02	(2)	1.18	(4)	0.85	(1)
2		1.20	(1)	1.21	(1)	0.91	(1)	0.87	(2)
3		1.03	(2)	0.94	(3)	0.92	(2)	1.04	(3)
4		0.96	(3)	0.92	(4)	0.98	(3)	1.23	(4)
1	SINGAPORE	0.74	(4)	0.93	(2)	1.24	(4)	0.89	(2)
2		1.08	(2)	1.38	(1)	1.04	(3)	0.72	(1)
3		1.55	(1)	0.82	(4)	0.76	(2)	1.192	(4)
4		1.03	(3)	0.87	(3)	0.96	(2)	1.191	(3)
1	THAILAND	0.85	(4)	1.03	(2)	1.14	(4)	0.86	(2)
2		1.20	(1)	1.27	(1)	0.94	(1)	0.83	(1)
3		1.03	(2)	0.95	(3)	0.95	(2)	1.03	(3)
4		0.93	(3)	0.75	(4)	0.96	(3)	1.28	(4)

Appendix C : Multiplier Analysis

Sector/Country	Multiplier	(Rank)	Type IA	(Rank)	Type IB	(Rank)	Type IIA	(Rank)	Type IIB	(Rank)
1 AUSTRALIA	2.50	(4)	1.69	(4)	2.16	(2)	3.99	(2)	2.99	(2)
2	1.64	(3)	1.64	(3)	2.21	(1)	4.09	(1)	3.09	(1)
3	3.19	(1)	1.34	(1)	1.55	(3)	2.86	(3)	1.96	(3)
4	3.17	(2)	1.23	(2)	1.35	(4)	2.49	(4)	1.49	(4)
1 FIJI	2.05	(4)	1.16	(3)	1.21	(3)	1.97	(3)	1.97	(3)
2	2.06	(3)	2.31	(1)	2.66	(1)	4.33	(1)	3.33	(1)
3	2.36	(1)	1.23	(2)	1.32	(2)	2.16	(2)	1.16	(2)
4	2.25	(2)	1.12	(4)	1.13	(4)	1.85	(4)	0.85	(4)
1 NEW ZEALAND	2.35	(4)	1.77	(1)	2.36	(1)	4.01	(1)	3.01	(1)
2	2.84	(2)	1.52	(2)	1.96	(2)	3.33	(2)	2.33	(2)
3	2.83	(3)	1.36	(3)	1.55	(3)	2.64	(3)	1.64	(3)
4	2.91	(1)	1.22	(4)	1.33	(4)	2.26	(4)	1.26	(4)
1 PAPUA NEW GUINEA	1.41	(4)	1.40	(2)	1.62	(2)	2.11	(2)	1.11	(2)
2	1.98	(3)	1.79	(1)	2.20	(1)	2.86	(1)	1.86	(1)
3	2.30	(1)	1.36	(3)	1.54	(3)	2.00	(3)	1.00	(3)
4	2.12	(2)	1.13	(4)	1.19	(4)	1.55	(4)	0.55	(4)
1 INDONESIA	1.51	(4)	1.23	(2)	1.32	(2)	1.65	(2)	1.65	(2)
2	1.99	(2)	1.80	(1)	2.18	(1)	2.73	(1)	1.73	(1)
3	2.13	(1)	1.20	(3)	1.30	(3)	1.62	(3)	0.62	(3)
4	1.85	(3)	1.19	(4)	1.28	(4)	1.59	(4)	0.59	(4)
1 MALAYSIA	1.43	(4)	1.23	(2)	1.36	(2)	1.76	(2)	0.76	(2)
2	1.94	(3)	1.84	(1)	2.22	(1)	2.89	(1)	1.89	(1)
3	2.15	(1)	1.15	(3)	1.21	(4)	1.58	(4)	0.58	(4)
4	1.99	(2)	1.17	(4)	1.24	(3)	1.61	(3)	0.61	(3)
1 PHILIPPINES	1.86	(4)	1.10	(4)	1.18	(4)	1.58	(4)	0.58	(4)
2	2.30	(2)	2.93	(1)	3.91	(1)	5.26	(1)	4.26	(1)
3	2.41	(1)	1.19	(3)	1.35	(3)	1.82	(3)	4.26	(1)
4	2.11	(3)	1.28	(2)	1.45	(2)	1.95	(2)	0.95	(2)
1 SINGAPORE	1.45	(4)	1.38	(2)	1.61	(2)	2.84	(2)	1.89	(2)
2	2.58	(3)	1.48	(1)	1.76	(1)	3.09	(1)	2.09	(1)
3	2.41	(1)	1.19	(3)	1.35	(3)	1.82	(3)	0.82	(3)
4	2.11	(3)	1.28	(2)	1.45	(2)	1.95	(2)	0.95	(3)
1 THAILAND	1.51	(4)	1.52	(4)	1.46	(2)	1.86	(2)	0.86	(2)
2	2.16	(2)	2.16	(2)	2.22	(1)	2.84	(1)	1.84	(1)
3	2.20	(1)	2.20	(1)	1.32	(3)	1.69	(3)	0.69	(3)
4	2.14	(3)	2.14	(3)	1.22	(4)	1.56	(4)	0.56	(4)

Appendix D : Methodology of Linkages and Multipliers

Linkage and Spreads :

: Backward linkages : Normalised column means of Leontief inverse.

: Forward linkages : Normalised row means of Leontief inverse.

: Backward spreads : Normalised row coefficient of variation.

: Forward spreads : Normalised column coefficient of variation.

Normalisation refers to division by grand mean or average of the means.

Multipliers :

$$\text{Type IA Income} = \frac{\text{Initial} + \text{First Round effects}}{\text{Initial effects}}$$

$$\text{Type IB Income} = \frac{\text{Initial} + \text{Production Induced effects}}{\text{Initial effects}}$$

$$\text{Type IIA Income} = \frac{\text{Initial} + \text{Production induced} + \text{Consumption induced}}{\text{Initial effects}}$$

$$\text{Type IIB Income} = \frac{\text{Flow on effects}}{\text{Initial effects}}$$

Source : Jensen and West, 1980.