A MODEL OF AID IMPACT IN SOME SOUTH PACIFIC MICROSTATES

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Summary — This paper investigates the impact of foreign aid on the economic structure of the recipient economy using a two-sector general equilibrium model. Underlying assumptions are designed to mirror a number of stylized facts about a group of South Pacific microstates known as MIRAB countries. Two variants of the model are constructed to reflect these countries' unequal access to overseas labor markets. Qualitative results reveal the likelihood of a structural transformation of the economy akin to that known as Dutch Disease, namely the relative contraction of the tradables sector. Quantitative results confirm the plausibility of this outcome.

Keywords — Pacific, MIRAB, microstates, foreign aid, Dutch Disease, development.

1. INTRODUCTION

As is common knowledge, and as Table 1 illustrates, the Pacific Ocean region is traditionally a high aid-receiving region, in comparison with other developing areas of the globe.

Table 1 **Comparison of Official Development Assistance (ODA) per capita in selected country groupings** (1995, US$)

Country grouping	ODA per capita	Country Grouping	ODA per capita
Least Developed Countries	28.4	Pacific Ocean	
Low Income Countries	4.5	Self-Governing	1089.5
Lower Middle Income Countries	12.8	Non-Self-Governing	1703.6
Upper Middle Income Countries	1.3	Indian Ocean	
Sub-Saharan Africa	31.7	Self-Governing	227.5
		Non-Self-Governing	988.1
Caribbean		Atlantic Ocean	
Self-Governing	188.5	Self-Governing	294.2
Non-Self-Governing	325.6	Non-Self-Governing	1475.0

Sources: Constructed from OECD 1997, *Geographical Distribution of Financial Flows to Aid Recipients* and World Bank 1997, *World Development Indicators*.

Within this high-aid environment, microstates receive even more generous amounts of aid than their larger counterparts (see Table 2), in a further instance of the well-documented 'small country bias' of aid donors.

Table 2 **Ratio of aid to GDP in selected South Pacific countries**

Country	Ratio (%)	Year	Country	Ratio (%)	Year
Cook Islands	24	1992	Tokelau	349	1990
Fiji	4	1992	Tonga	25	1992
Kiribati	73	1992	Tuvalu	49	1992
Niue	121	1992	Vanuatu	17	1992
PNG	10	1992	Western Samoa	35	1992
Solomon Islands	12	1992	**Average**	**65**	

Sources: NCDS, *Pacific Economic Bulletin*, various issues; SPESD; Weisman 1990; Poirine 1995 (Appendix).

Five of these microstates, Kiribati, Tuvalu, Niue, Tokelau and the Cook Islands, are sometimes referred to collectively as MIRAB countries, after the Migration Aid Remittances

Bureaucracy model proposed by Bertram (1986, 1993, 1999) and Bertram and Watters (1985, 1986). In recent times, aid to these countries has remained very bountiful, if somewhat variable, in absolute as well as in relative terms (see Figures 1 and 2).

Figure 1 **Real aid flows to MIRAB countries**
(A$'000 at 1982 prices)
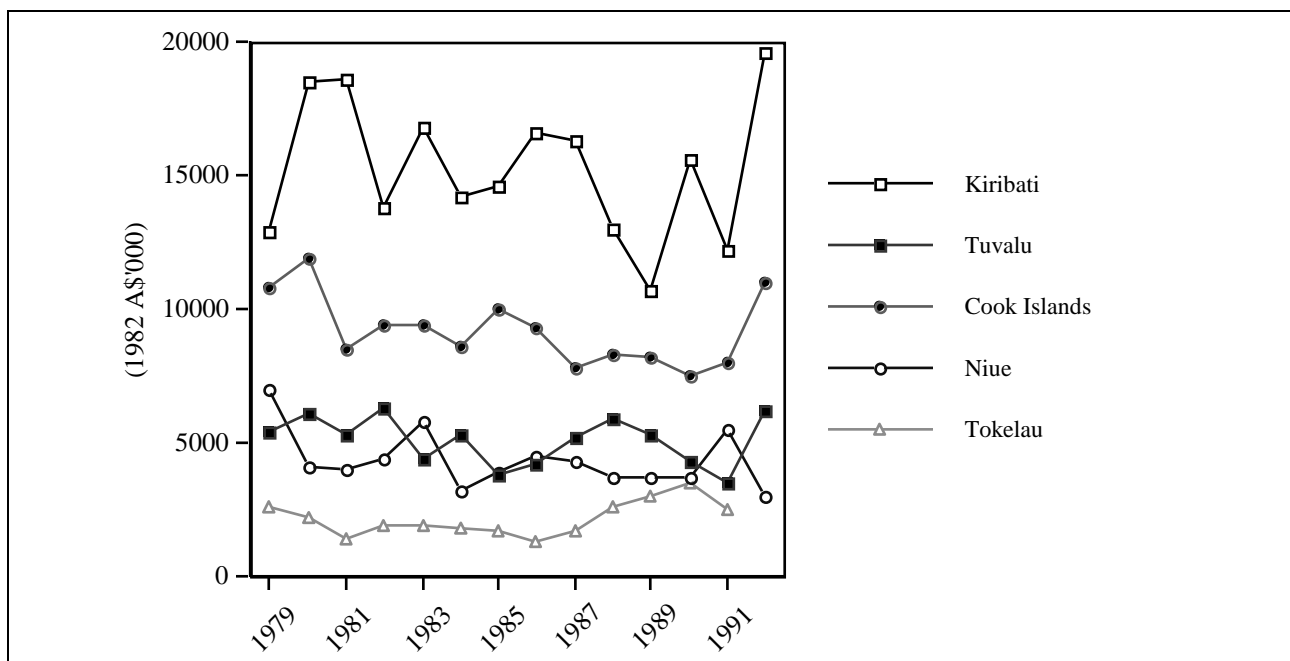
Sources: SPC; SPESD; NCDS, *Pacific Economic Bulletin*; Booth and Muthiah 1992.

Notwithstanding sizeable aid inflows, the MIRAB economies have not always achieved satisfactory growth, and some, like Kiribati, could well be considered the epitome of the so-called 'Pacific Paradox'.[i] In addition to highly variable growth rates, these microstates are typically characterized by deteriorating trade balances and public sector finances (see e.g. Bertram 1993). The economic crisis that affected the Cook Islands in 1996 exemplified such trends.[ii] Overall, it appears that these countries are in the grip of a transformation leading them away from their professed goal of greater economic independence.

Figure 2 **Aid as a percentage of GDP in MIRAB economies**[a]
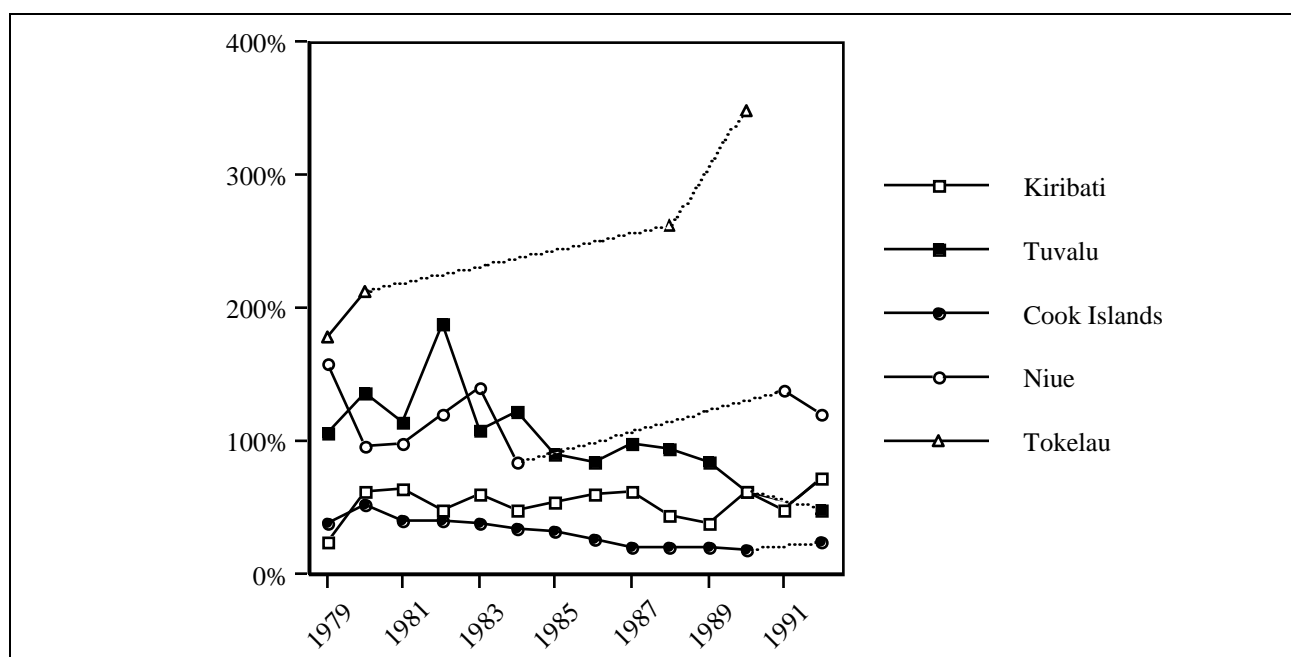
[a] No information is available for Tokelau (1981-87, 1989), Niue (1985-90), Tuvalu (1991) and the Cook Islands (1991).

Sources: SPC; SPESD; NCDS, *Pacific Economic Bulletin*; Mataio 1991; Booth and Muthiah 1992; CIA 1995; Poirine 1995 (Appendix).

The MIRAB theory seeks to explain this transformation. According to this theory, large aid flows (in conjunction with other forms of rent income such as migrant remittances) are causing booming sector or Dutch Disease effects in the recipient economy, with adverse consequences for international competitiveness and economic structure. This is, indeed, a view of foreign aid's macroeconomic impact which has gained considerable prominence since the mid-1980s (e.g. van Wijnbergen 1986, Weisman 1990, White 1992, Younger 1992).

The study of the impact of aid on economic growth and its determinants (e.g. saving, the incremental capital-output ratio) is as old as aid itself. It is characterized by a succession of paradigms and models which have become dominant before being discarded or supplanted e.g. early Lewis-type growth models, the two-gap model, the fiscal response model, etc. In the course of this evolution in thinking about aid, the purported benefits of aid in terms of its impact on economic growth have been constantly re-assessed, often critically.

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The latest model to gain prominence in this area is the so-called trade-theoretic model of aid, which approaches aid in terms of its differential impact on the tradables and the non-tradables sectors. It is, therefore, related to such analyses as the Salter model (1959) and the Gregory Thesis (1976), although its main exponent has been van Wijnbergen (1984, 1986). This model's crucial tenet is that the expenditure of aid monies will alter the general equilibrium in an economy, with both producers and consumers revising their optimizing decisions. Typically, because of the price constraints on tradable goods (small country assumption), the expenditure of aid monies leads to an appreciation of the real exchange rate (i.e. the prices of non-tradables increase relative to the prices of tradables). This appreciation, in turn, leads to a fall in the production and a rise in the consumption of tradable commodities, and to the reverse for non-tradable goods and services. As mentioned, this is a structural transformation akin to that known as the Dutch Disease or booming sector effect, first detected in the context of countries receiving windfall oil and gas revenue (Corden and Neary 1982, van Wijnbergen 1984). In a country in the grip of this effect, the non-booming tradables sectors find their performance hindered by the growth of the booming sector. In particular, this sector is able to draw resources away from the non-booming sectors (the resource movement effect) by bidding up their price.

According to MIRAB theorists, a similar phenomenon is occurring in the five countries previously mentioned (and possibly in other South Pacific countries as well e.g. Western Samoa, Tonga, Papua New Guinea, French Polynesia). To quote Bertram (1999, p. 111):

> "the size and persistence of financial flows into island economies from overseas, and labor migration out, have the effect of making capitalist private-sector activity unprofitable because of the resulting combination of strong exchange rates and high wages."

In these countries, the booming sector is the public sector which, because of the abundance of aid money, has taken over many private sector activities in addition to expanding its traditional activities. Furthermore, to the extent that the populations of some of these countries have gained

access, through emigration, to the high-wage labor markets of metropolitan economies such as Australia and New Zealand, domestic real wages have risen independently of local economic conditions. This development has had a directly depressive influence on both the tradables and non-tradables sectors, with the impact on the tradables sector exacerbated by the contribution that migrant remittances have made to upward pressure on the real exchange rate. It should be noted that, because MIRAB countries do not have their own currency, nominal exchange rate re-alignment is not available as a policy tool with which to protect the competitive position of the tradables sector.[iii] Overall, the view that the growth of the tradables sector has been impeded by aid in MIRAB economies appears to be supported by empirical evidence, both microeconomic (Hooper 1993) and macroeconomic (Laplagne 1997). As the above quote from Bertram (1999) makes clear, this is also a view which one of the creators of the MIRAB model continues to hold.

The distortionary effects of foreign aid are frequently put forward to explain the perceived 'failure' of development assistance in the South Pacific. Lending agencies themselves have subscribed to this explanation (eg World Bank 1991). There are, however, dissenting voices. Cook and Kirkpatrick (1998) use an unemployment and immigration-augmented version of Bertram's (1986) graphical MIRAB model to analyze the effects of aid reduction on a MIRAB-like country, the Federated States of Micronesia (FSM). They conclude that, when immigrant foreign labor is available at wages below the exogenous nominal wage, aid-financed public expenditure does not crowd out private activity through wage effects. Indeed, they argue that 'crowding in' of private sector activity occurs, through multiplier effects (1998, p. 853).

However, like Bertram's (1986), their analysis does not explicitly recognize that it is the tradable/non-tradable dichotomy, rather than the public/private one, which governs the effects of aid on economic structure. Thus, if aid to the public sector does not hamper the growth of the private sector, price movements may nonetheless encourage the latter to reallocate resources to the

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production of non-tradable goods demanded by the former. Cook and Kirkpatrick themselves acknowledge that 'a large share of private sector employment is in non-traded good activities' (1998, p. 851).

In sections 2 and 3 of this paper, two variants of a theoretical model of the MIRAB economy are presented, with a view to understanding better the effects of an aid inflow. A full algebraic version of the model is provided in Appendix II, but the following presentation is mainly graphical. In section 4, the model is applied to economic data to generate quantitative results. Section 5 provides some policy simulations and conclusions.

2. MODEL 1: UNRESTRICTED EMIGRATION

This is a two-sector general equilibrium model of the formal sector of a "typical" MIRAB economy with a migration outlet (the metropolitan country). It is used for comparative static purposes, to study the short-run (SR) and long-run (LR) impact of aid on the sectoral composition of output and employment in the economy. The framework of the model is derived from Corden and Findlay (1975).

The two time frames mentioned above are defined as follows:

- <u>SR</u>: defined as the period of time when aid monies are spent on consumption and investment, but in the latter case do not yet translate into additions to sectoral capital stocks; and

- <u>LR</u>: the period of time when aid results in new infrastructure, plant, and equipment i.e. it brings an increase in sectoral capital stocks.

The assumptions underlying the model are listed below:

- unlimited and costless emigration from island to metropolitan country;[iv]

- two sectors: tradables (T) and non-tradables (NT);

- constant returns to scale (CRS) sectoral production functions (specifically, Cobb-Douglas);

- two factors: labor (L) and capital (K);

- no technical progress;

- perfect competition and profit maximization by producers obtain in both sectors;

- small country assumption with respect to the price of tradables (i.e. the country is a price-taker in world markets);

- fixed nominal exchange rate (equal to one in the absence of a separate currency);

- the domestic price level (P) is a weighted average of the prices of tradables (P_t) and non-tradables (P_{nt}):

$$P = \theta P_t + (1 - \theta)P_{nt} \qquad (1)$$

   where θ = weight of tradable goods in price index ($0 < \theta < 1$)

- foreign real wage parity i.e. an economy-wide real wage rate identical to that in the migration outlet:

$$\frac{W}{P} = \overline{w} \qquad (2)$$

   where   W = economy-wide domestic nominal wage

           $\overline{w}$ = foreign real wage (exogenous)

This parity follows from the assumption of unlimited and costless emigration of surplus labor, and the assumed absence of any binding minimum wage in the island economy.

The initial equilibrium in terms of the labor market is as illustrated in Figure 3.

Figure 3 **Labor market equilibrium in the two-sector economy with an unrestricted emigration outlet**
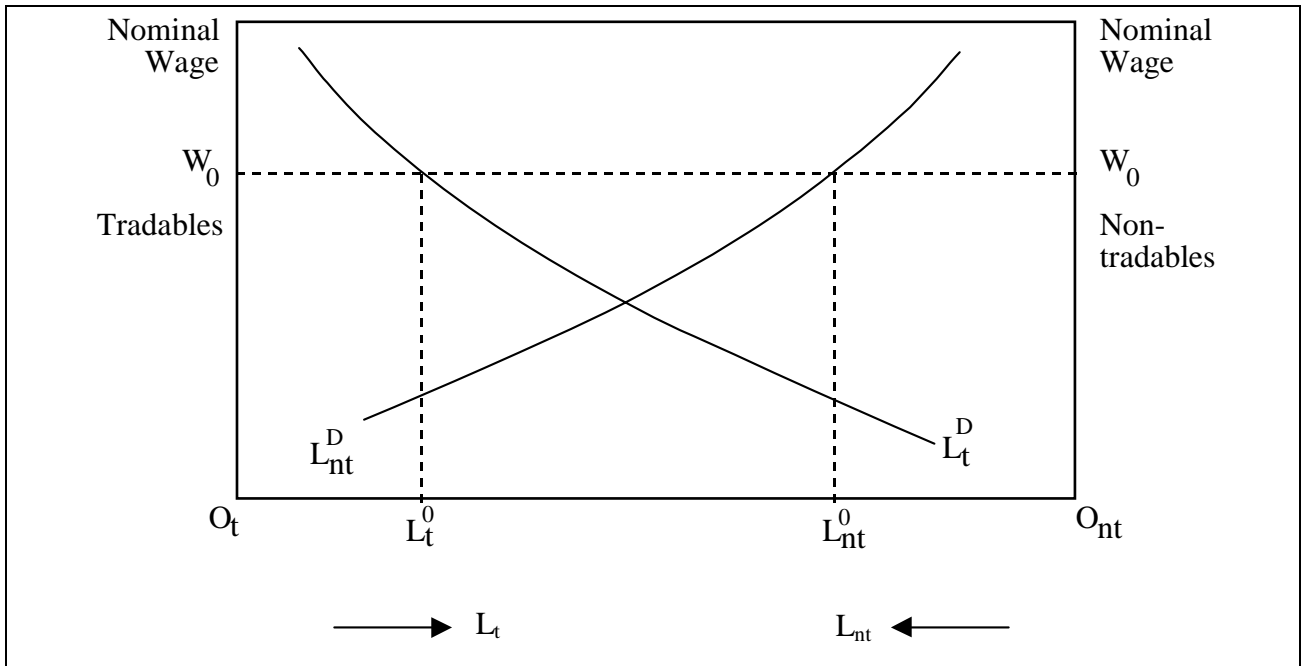
In this diagram, the quantities of labor demanded by the T and NT sectors are measured on the horizontal axis, from the O_t and O_{nt} origins respectively, with total labor supply measured by distance O_t-O_{nt}.

SR labor demand curves are derived from CRS Cobb-Douglas production functions with capital and sectoral price levels held constant, and are of the form:

$$L_t^D = \left(\frac{\beta P_t}{W}\right)^{\frac{1}{\alpha}} K_t \tag{3}$$

$$L_{nt}^D = \left(\frac{\delta P_{nt}}{W}\right)^{\frac{1}{\gamma}} K_{nt} \tag{4}$$

where α, β, δ and γ are factor share parameters (see Appendix I).

At the exogenously determined initial nominal wage W_0, the T sector employs L_t^0 workers and the NT sector L_{nt}^0 workers. This implies a total stock of emigrant labor equal to the distance $L_t^0 - L_{nt}^0$.

In the SR, a 'one-off' financial aid inflow is spent on both T and NT goods, which results in an increase in demand (consumption and investment) for both these sectors' output. However, only the price of NT goods rises as a result (small country assumption). Given equations (1) and (2), it follows that the own-sector real wage (W/P_{nt}) faced by NT producers falls, while that faced by T producers (W/P_t) rises (with both sectors facing the same increase in the economy-wide nominal wage rate, W_0 to W_1). This impacts on these sectors' respective labor demands in the fashion illustrated in Figure 4.

In order to continue to optimize their use of labor, the two sectors need to alter their capital-labor ratios to equate their marginal products of labor with their new own-sector real wages. This means that the T sector will reduce its workforce, while that of the NT sector increases. The short run consequences of the aid inflow are therefore that:

- the own-sector real wage rate faced by the T sector rises, while that faced by the NT sector falls;

- employment and output in the NT sector rise;

- employment and output in the T sector fall;

- the real exchange rate appreciates (P_t/P_{nt} falls); and

- the price level increases.

Figure 4 **Short run effects of an aid inflow in the labor market**
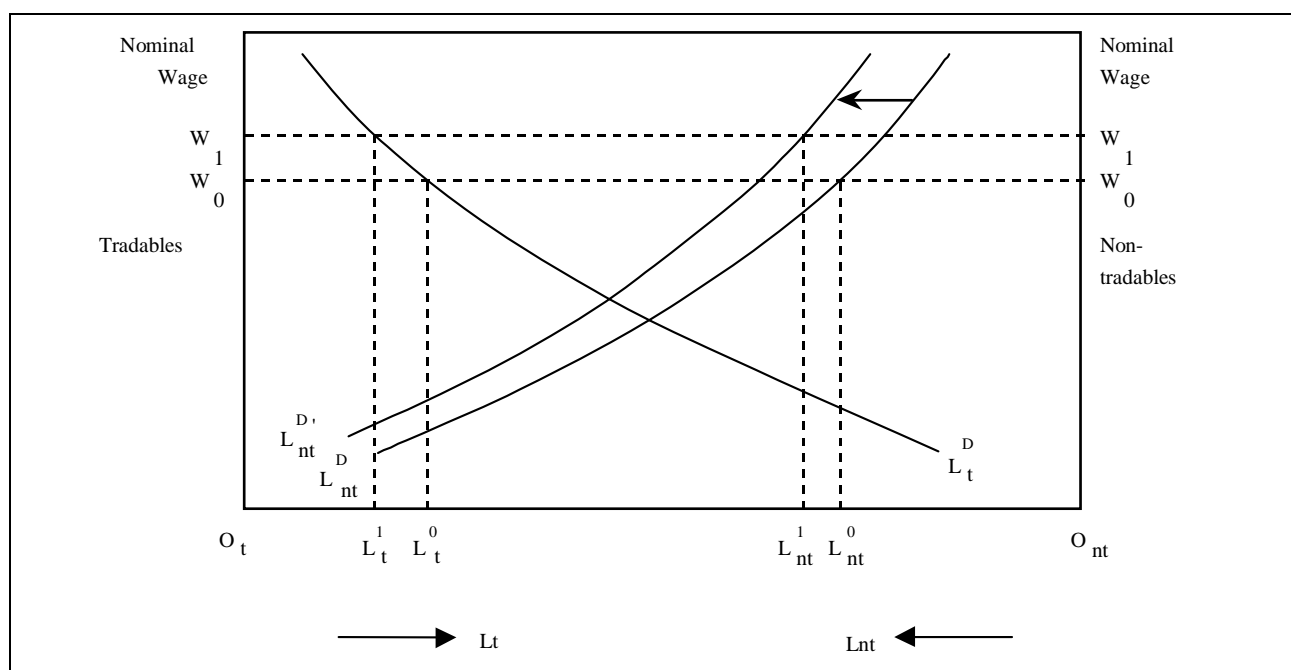
Note: The shift in L_{nt}^{D} is caused by the fact that, at each level of nominal wage W, a higher value of P_{nt} has reduced the real cost of labor in that sector, so that more labor can be profitably employed. In contrast, P_t has remained constant, so that the L_t^{D} curve does not shift.

Whether total employment and total output in the economy rise or fall cannot be determined from the diagram as this depends on sectoral factor intensities,[v] the weight of each commodity in the price index, and the relative values of P_t and P_{nt}.

In the SR therefore, an aid inflow will cause a structural change of the kind predicted by booming sector theory. Here, the booming sector is the NT sector, while the T sector is experiencing lower levels of competitiveness and performance.

Between the SR and the LR, the expenditure associated with the "one-off" aid inflow reverts to zero. However, the impact of this inflow continues to be felt in the LR, as the portion of aid that was invested in the SR now adds to each sector's capital stock. As a result, marginal labor productivity rises in both sectors, which leads to more labor being employed at each nominal wage rate. As a result, sectoral output and employment increase to the same extent as the capital stock (as

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the real wage remains constant, each sector must restore capital-labor ratios to pre-existing figures to maximize profit). This is a *first-stage change*.

As the economy's output increases, so does its national income (measured at constant prices). Increased absorption of both commodities ensues, which may result in a supply-demand imbalance developing in the market for NT goods.[vi] The resulting change in P_{nt} is a *second-stage change*. Its direction will depend crucially on a number of factors such as price and income elasticities and sectoral aid allocation.

Assuming *pro tem* that a rise in the price of NT goods follows the emergence of excess demand in that sector, the LR impact of the aid flow may be illustrated as shown in Figure 5, and consists of:

Figure 5 **Long run effects of an aid inflow in the labor market**
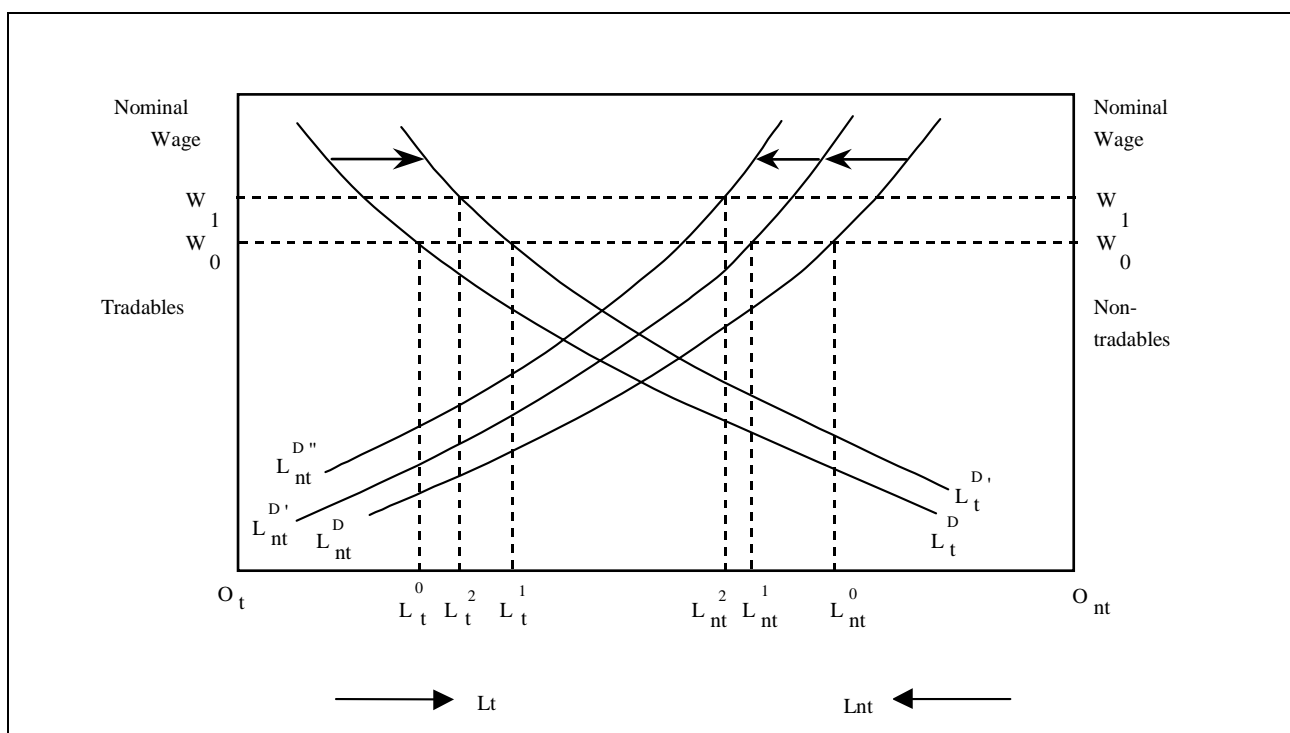
- <u>first-stage changes</u>: L_t^0 to L_t^1 and L_{nt}^0 to L_{nt}^1

- <u>second-stage changes</u>: L_t^1 to L_t^2, L_{nt}^1 to L_{nt}^2

The impact of these changes on sectoral output and employment is unambiguous where first-stage changes are concerned. Both variables increase in each sector. What happens to output and employment in the second stage will clearly depend upon the direction of change of P_{nt}. If P_{nt} increases, then the effect will be identical to that already described for the SR. If P_{nt} decreases, then the reverse will occur. This makes it hard to know a priori whether the combined effect on each sector is an expansion or a contraction. However, the mathematical specification and solution of the model (see Appendices I and II) enable the factors that influence the direction of change of P_{nt} to be determined. They are:

- the sectoral breakdown of the aid inflow and, through it, the proportional increase in sectoral capital stocks and output;

- the sectoral elasticities of supply with respect to changes in the price of NT goods only;

- the real income and relative price elasticities of the absorption of NT goods; and

- the initial sectoral shares of real GDP.

Once the direction and magnitude of the change in P_{nt} are known, the change in output and employment in each sector become known also (see section 4).

3. MODEL 2: RESTRICTED EMIGRATION

In this variant of the model, no significant international emigration is allowed. This is thought to be more realistic where Kiribati and Tuvalu are concerned (especially since the closure of Nauru's phosphate mining operations). The non-tradables sector (consisting mainly of the public

sector in its broadest sense) retains an exogenous perceived real wage from a worker viewpoint, but this is now determined institutionally — through political choice as in the FSM (Cook and Kirkpatrick 1998), or by reference to an external benchmark such as merchant seamen's wages as in Kiribati (Kiribati 1992) — rather than by unlimited and costless emigration. The indexation mechanism is analogous to that of Model 1:

$$\overline{w} = \frac{W_{nt}}{P} \tag{5}$$

where W_{nt} = nominal wage in sector NT

By contrast, the perceived real wage in the tradables sector $\left(\dfrac{W_t}{P} \right)$ is now assumed to be endogenous. This is because, in this second model, a new dimension of migration affecting the MIRAB countries is incorporated, namely internal migration from the periphery (outlying islands) to the center (capital). This is a demographic trend the existence of which has been reported in some MIRAB countries (e.g. Munro 1990, Kiribati 1992, Tonganibeia 1993). Here, it is assumed that this emigration follows a well-known Harris-Todaro (1970) process, whereby unemployment is consistent with equilibrium in the labor market. This is because equilibrium obtains when the wage rate in the rural (tradables) sector is equal to the expected urban (non-tradables) wage rate (= urban wage rate x the probability of being employed). When this equality is reached, internal migration from the rural to the urban sector ceases, and a pool of urban unemployment persists.[vii]

As shown by Corden and Findlay (1975), the initial equilibrium in the presence of a Harris-Todaro process is as illustrated in Figure 6. Rather than equilibrium obtaining where the two labor demand curves intersect (point C), it now occurs at B where the L_t^D curve meets the rectangular hyperbola RR' passing through point A on the L_{nt}^D curve. At point B, the nominal wage rate in the

tradables sector (W_t) is equal to the expected value of the nominal wage rate in the non-tradables sector, given by:

$$E(W_{nt}) = W_{nt}\left[\frac{L_{nt}}{\overline{L} - L_t}\right] \qquad (6)$$

where $\overline{L}$ = total supply of labor to the economy (and the bracketed expression on the right hand side therefore measures the urban employment rate).

Figure 6 **Labor market equilibrium with a Harris-Todaro migration process**
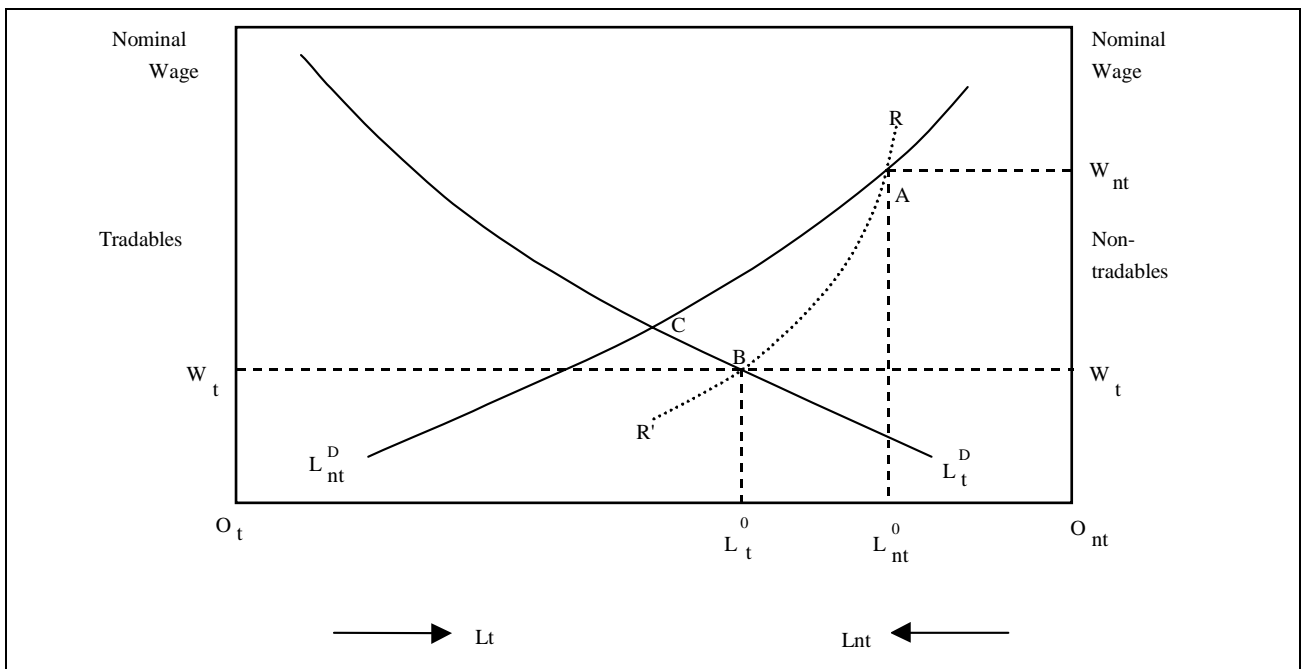
Assuming once again a 'one-off' aid inflow in the SR, the initial equilibrium will be perturbed in the manner reflected in Figure 7.

As can be seen from that diagram, qualitative results are the same as in Model 1, namely:

- sectoral output and employment increase in sector NT; and

- sectoral output and employment decrease in sector T.

Figure 7 **Short run impact of an aid inflow in an economy with no migration outlet**
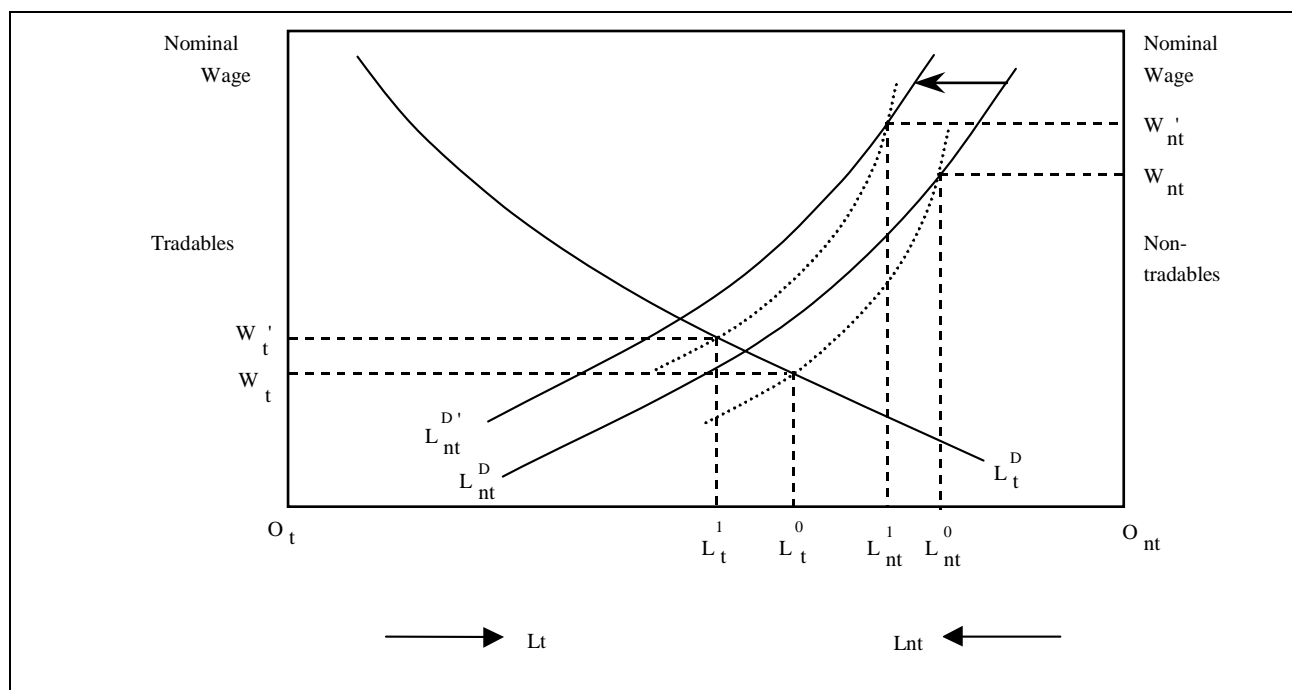
Following the aid-financed injection of capital into both sectors, both labor demand curves will shift out in the long run, with the rectangular hyperbola showing the point of labor market equilibrium. If we assume that, here also, P_{nt} increases as a result of excess demand in that sector, a further shift in L_{nt} will occur, accompanied by a reduction in output and employment in the tradables sector (see Figure 8).

In this model also, a priori knowledge of the combined impact of capital growth (first-stage) and price (second-stage) changes upon the size of each sector is not possible. However, solving the fully specified and parameterized model (see Appendices I and II), numerical estimates of the percentage changes in all the unknown variables can be obtained (see section 4). In this way, the direction and extent of changes in sectoral output and employment (and thus total unemployment) can be known.

The majority of qualitative results from both models lend support to the hypothesis that an aid inflow is likely to cause a reduction in the size of the tradables sector, in relative and/or absolute

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terms. However, it remains to be confirmed whether this conclusion is supported by quantitative results once the model's parameters are estimated numerically and the model solved empirically.

Figure 8 **Long run impact of an aid inflow in an economy with no emigration outlet**
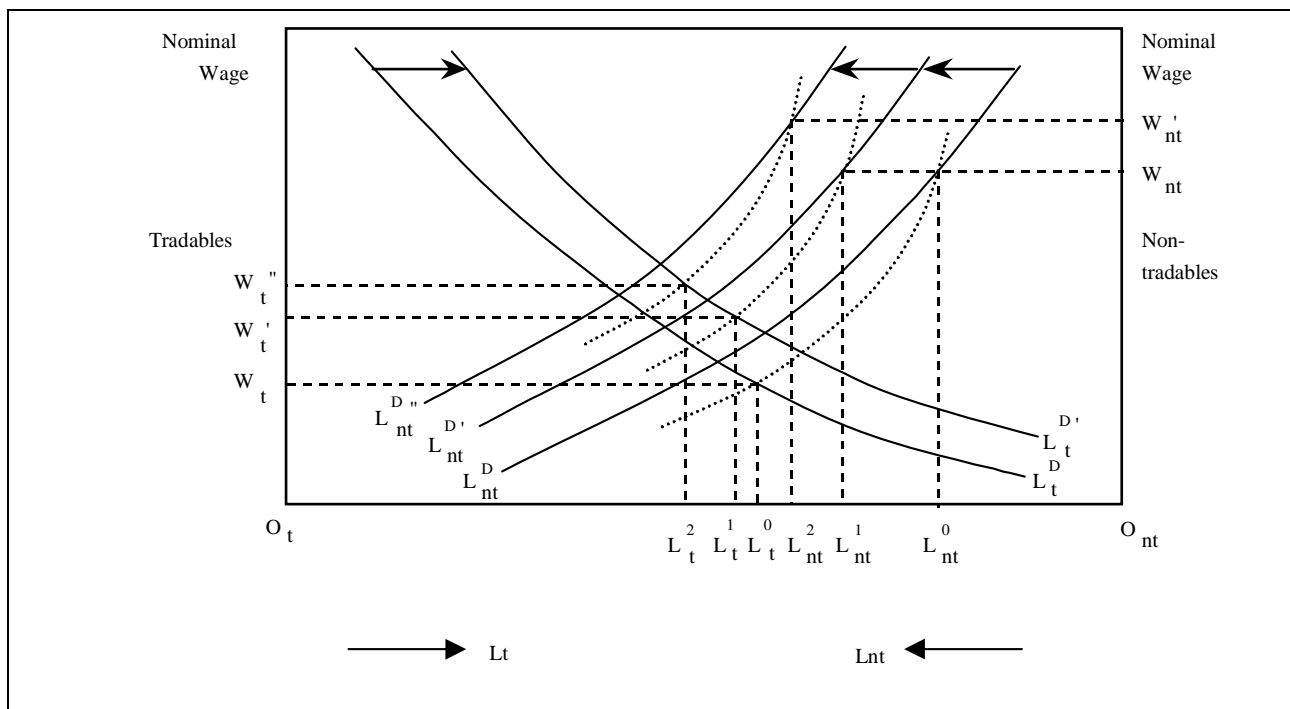
4. EMPIRICAL RESULTS

For each variant of the model, a single representative country is chosen, a decision largely motivated by the lack of sufficient data for all MIRAB countries. For the unrestricted emigration case (Model 1), published data for the Cook Islands are used while, for the restricted case (Model 2), Kiribati data are used. In both instances, the data pertain to the 1980s period.

The numerical estimates for the model parameters and pre-determined variables are shown in Appendix I. Some pre-determined variables, such as P_t and P_{nt} are assigned arbitrary starting values of 100 (hence $P = 100$ initially).

The models are Johansen-style models (1960), hence they are linear in the logs. Variables in the models are expressed as percentage changes (using the notation $\hat{x}$), and each variant of the

model is solved for both the short-run and the long-run. Two further assumptions are required at this point:

- the 'one-off' aid inflow (an exogenous variable) is assumed to be equal to 10 per cent of GDP. This is not meant to mirror reality (see Table 2) but, rather, to facilitate comparisons between models (and countries). Furthermore, Johansen-style linearization precludes the simulation of overly large proportional shocks; and

- given the magnitude of this aid inflow, the proportional changes in sectoral capital stocks which aid causes in the long run are set equal to 6.25 per cent. This figure is based on data in King and Levine (1994), which show the capital-output ratio of 87 developing countries to have averaged 1.6 in the 1980s. It is further assumed that incremental and average ratios are equal.

The main results from the solution of the two models and time frames are presented in Table 3. From that table, the prevalence of Dutch Disease effects, following an injection of aid, is apparent. Even when the tradables sector is growing in absolute terms — as is the case in regard to its output in both the LR models — it is experiencing a decline in relative terms. Another sign of the disease, namely real exchange rate appreciation (due to an increase in P_{nt} while P_t remains constant by definition), is found in all cases except the long run restricted model. Thus, the results obtained here offer broad support to the contention of MIRAB and aid theorists that the impact of aid on the economic structure of the recipient serves to hinder the tradables sector and its capacity to retain workers. Or, to use Cook and Kirkpatrick's (1998) terminology, these results show the public (non-tradables) sector crowding out the private (tradables) sector.

Table 3 **Summary of numerical results**

Unrestricted Emigration Model	(Model 1)	Impact of aid on:							
		P_{nt}	L_t	L_{nt}	X_t	X_{nt}	W/P [c]	Domestic employment	Total Output [e]
SR [a]	Percentage Δ	25.04	-46.38	26.09	-33.85	13.56	Constant	16	9.29
	Absolute Δ	n.a.	-288	1,043	-2,239	10,913	n.a.	755	n.a.
LR [b]	Percentage Δ	1.53	3.39	7.85	4.16	7.08	Constant	7.25	6.82
	Absolute Δ	n.a.	21	314	226	2,878	n.a.	335	n.a.
Restricted Emigration Model	(Model 2)	Impact of aid on:							
		P_{nt}	L_t	L_{nt}	X_t	X_{nt}	W_t/P [d]	Unem-ployment	Total Output
SR [a]	Percentage Δ	10.57	-24.75	15.54	-15.34	7.92	6.45	-61	3.27
	Absolute Δ	n.a.	-737	1,154	-1,326	2,001	n.a.	-417	n.a.
LR [b]	Percentage Δ	-1.78	-1.01	3.63	1.74	4.91	3.26	-35.1	4.28
	Absolute Δ	n.a.	-30	270	103	935	n.a.	-240	n.a.

[a] Assuming a real aid inflow equal to 10 per cent of real GDP. [b] Assuming $\hat{K}_t = \hat{K}_{nt}$ = 6.25 per cent. [c] Economy-wide perceived real wage. [d] Perceived real wage in the T sector. [e] Measured at constant prices.
Note: n.a. = not applicable.

Nevertheless, the aid inflow does not only produce negatives. As can be seen from the table, an injection of aid leads, in both the SR and the LR, to an increase in overall domestic employment and output. Furthermore, in Model 2, the growth in the latter exceeds that in the former (not shown), reflecting the fact that average labor productivity has been lifted by aid. Given the assumed constancy of the real wage in the NT sector (second model), this improvement in labor productivity is wholly due to the T sector. In addition, workers in the T sector are better off, as their perceived real wage (W_t/P) has increased by 3.26 per cent in the LR. Conversely, in Model 1 the perceived real wage has not changed while average labor productivity in the entire economy has declined, as reflected in an output growth rate of 6.8 per cent, compared to 7.3 per cent for employment.

The employment growth recorded in both models may be of benefit to countries faced with a rapid population increase and a shortage of village-based employment opportunities. However, the growth in overall employment is almost exclusively due to the non-tradables sector. If one accepts the assumption that this sector is largely urban-based, its growth may be judged undesirable in countries confronted with the overcrowding of their capital (e.g. Kiribati, Tuvalu). Nonetheless, a positive aspect of the aid impact is a significant reduction in unemployment in the restricted model (unemployment is assumed to be non-existent in the unrestricted model, given the possibility of emigration).

Ultimately, the results shown above must be qualified in the light of the unrealistically high labor demand elasticities implicit in the Cobb-Douglas production functions (see endnote v). If lower elasticity values were used, the quantitative results in Table 3 would be reduced accordingly; qualitative results, in particular the differences in sectoral impact, would not be affected, however. Conversely, quantitative results would increase if more realistic values for the aid/GDP ratio were used in the calculations (see Table 2).

5. DISCUSSION AND CONCLUSION

In this paper, a general equilibrium model of a typical MIRAB economy was built to evaluate formally one of the central tenets of the MIRAB hypothesis, namely the occurrence of Dutch Disease effects following an aid inflow. In contrast to the suggested effects of aid in other parts of the Pacific (Cook and Kirkpatrick 1998), the Dutch Disease transformation of the recipient MIRAB economy appears to be highly likely, based on qualitative as well as quantitative results. This conclusion is reached even if — in a departure from the traditional MIRAB model — the possibility of internal migration and unemployment is modeled. The possibility of international immigration, postulated by Cook and Kirkpatrick (1998) was not envisaged, as it is not a feature of the countries under examination.

The results presented above are, however, consistent with Cook and Kirkpatrick's (1998) conclusion — and that of others (eg Treadgold and Laplagne 1996) — that foreign aid can effectively support employment and output growth in South Pacific microstates. On the other hand, the fact that this growth produces no or little benefits for the tradables sector may be regarded less than favorably by island governments. This could be due to reasons of economic sovereignty, independence, prestige, or, as mentioned above, to concerns about urban overcrowding and the disappearance of the traditional mode of production. Furthermore, in Model 1 (LR), the loss of international competitiveness due to real exchange rate appreciation is especially worrisome at a time when island authorities are implementing ambitious privatization and deregulation programs. There is a real risk that, once deprived of tariff protection and public subsidies, import-competing and export enterprises will not be able to survive inflated production costs.

In the absence of exchange-rate management tools, it is of interest to ask what, if anything, these countries can do to stop their slide towards increased dependency. One option available to governments intent on maintaining or expanding their tradables sector while preserving their claim on overseas aid is to re-apportion aid to contribute more to the growth of the tradables sector's capital stock. Producers in that sector, seeking to maintain the existing capital-labor ratio, would employ more workers and output would rise commensurately. However, the problem is not as simple as achieving as high a growth rate in K_t as possible. This is because $\hat{K}_t$ itself has a positive impact on $\hat{P}_{nt}$ (through increased absorption by the tradables sector); as $\hat{P}_{nt}$ increases, the T sector contracts and the NT sector expands, thus making the problem worse. Simulations carried out on the model by varying the assumed proportional growth in K_t reveal that a reversal of the relative contraction in the T sector is only achievable in terms of output, not in terms of employment (see Tables 4 and 5). That is, it is not possible to re-allocate aid in such a way that the growth in L_t will

exceed that in L_{nt} (in percentage terms). This is attributable to the secondary effects of $\hat{P}_{nt}$ mentioned above.

Table 4 **Values of** $\hat{K}_t$ **required for the relative expansion of the tradables sector** (unrestricted model)

Objective	Minimum $\hat{K}_t$ value (%) required[a]	Accompanying values (%) of				
		$\hat{P}_{nt}$	$\hat{L}_t$	$\hat{L}_{nt}$	$\hat{X}_t$	$\hat{X}_{nt}$
$\hat{X}_t \geq \hat{X}nt$	$\hat{K}_t = 17.55$	5.96	6.50	12.46	9.48	9.48
$\hat{L}_t \geq \hat{L}_{nt}$	Not achievable	n.a.	n.a.	n.a.	n.a.	n.a.

[a] Assuming $\hat{K}_{nt} = 6.25$ per cent.
Note: n.a. = not applicable.

Table 5 **Values of** $\hat{K}_t$ **required for the relative expansion of the tradables sector** (restricted model)

Objective	Minimum $\hat{K}_t$ value (%) required[a]	Accompanying values (%) of				
		$\hat{P}_{nt}$	$\hat{L}_t$	$\hat{L}_{nt}$	$\hat{X}_t$	$\hat{X}_{nt}$
$\hat{X}_t \geq \hat{X}nt$	$\hat{K}_t = 23.56$	2.24	-1.64	9.55	7.93	7.93
$\hat{L}_t \geq \hat{L}_{nt}$	Not achievable	n.a.	n.a.	n.a.	n.a.	n.a.

[a] Assuming $\hat{K}_{nt} = 6.25$ per cent.
Note: n.a. = not applicable.

In this matter, it is the relative size of the respective changes in sectoral capital stocks that matters. If $\hat{K}_{nt}$ was set at 1 per cent, then the value of $\hat{K}_t$ necessary to reverse the onset of the Dutch Disease would be (17.55/6.25 =) 2.8 per cent in Model 1 and (23.56/6.25 =) 3.7 in Model 2.

Nonetheless, in both models, an expansion in sector T's employment share would remain out of reach.

Another possible option for alleviating the Dutch Disease is to invest some of the aid monies overseas. This is an avenue which has been exploited successfully by nations receiving windfall revenues from oil exports or phosphate mining, for instance. These revenues have been used by these countries to accumulate net foreign assets, thus avoiding the problems associated with the immediate expenditure of all of these funds, and allowing intertemporal consumption smoothing. In the context of MIRAB economies, it could thus be argued that part of the aid funds would be more beneficially put on 'standby', for instance by diverting them into overseas trust funds, as in fact Kiribati and Tuvalu are doing already. In that way, their expenditure could be postponed until such time as it does not subject the market for non-tradable goods and services to undue inflationary pressures. However, whether a large-scale diversion of assistance would be acceptable to aid donors remains to be seen.

*   *   *

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APPENDIX I

Numerical estimates of model parameters

<u>Model 1 (unrestricted emigration)</u>   <u>Cook Islands data</u>

Parameter/Variable	Notation	Value	Source
Weight of P_t in P	θ	0.50	(a)
T sector's share of real GDP	λ	0.09	(a)
Income elasticity of absorption of non-tradables	η	1.06	(b)
Relative price elasticity of absorption of non-tradables	ε_{nt}	-1.06	(b)
Proportion of aid spent on non-tradables	σ	0.56	(a)
Capital's share of T sector output	α	0.27	(c)
Labor's share of T sector output	β	0.73	(c)
Capital's share of NT sector output	γ	0.48	(c)
Labor's share of NT sector output	δ	0.52	(c)
Short run increase in the absorption of non-tradables due to an aid inflow equal to 10 per cent (0.1) of GDP	$\frac{\sigma F}{P_t C_{nt}}$ *	0.061	(d)

<u>Model 2 (restricted emigration)</u>   <u>Kiribati data</u>

Parameter/Variable	Notation	Value	Source
Weight of P_t in P	θ	**0.72**	(a)
T sector's share of real GDP	λ	**0.20**	(a)
Income elasticity of absorption of non-tradables	η	1.06	(b)
Relative price elasticity of absorption of non-tradables	ε_{nt}	-1.06	(b)
Proportion of aid spent on non-tradables	σ	0.54	(a)
Capital's share of T sector output	α	0.38	(c)(e)
Labor's share of T sector output	β	0.62	(c)(e)
Capital's share of NT sector output	γ	0.49	(c)(e)
Labor's share of NT sector output	δ	0.51	(c)(e)

Total formal sector labor force	$\overline{L}$	11,084	(e)
Employment in sector T	L_t	2,979	(e)
Employment in sector NT	L_{nt}	7,423	(e)
Short run increase in the absorption of non-tradables due to an aid inflow equal to 10 per cent (0.1) of GDP	$\dfrac{\sigma F}{P_t C_{nt}}$ *	0.067	(d)

*: see Appendix II for the definition of F and C_{nt}.

Sources: (a) Calculated from South Pacific Economic and Social Database (SPESD) data. (b) Estimated econometrically from SPESD data for the Cook Islands (details of estimation available on request). (c) Constructed from SPESD data (details available on request). (d) Calculated by assuming an aid inflow to GDP ratio of ten per cent, a GDP share of the NT sector equal to (1-λ), and a proportion of aid spent on non-tradables equal to σ. Thus, the aid inflow leads to a $\left(\dfrac{0.1 \times 0.56}{0.91} = \right)0.061$ (or 6.1 per cent) increase in the absorption of non-tradables in the Cook Islands. (e) Estimated from AIDAB 1992 data (details available on request).

APPENDIX II
Algebraic models and solutions

Note: All the models in this appendix are in the form of Johansen (1960) models, that is, they are linear in the logs. They can therefore be solved using matrix algebra techniques such as matrix inversion or Cramer's Rule. The latter method is used here, although space constraints preclude a full exposition of the solutions derivation. Detailed workings are available from the authors on request.

A2.1 SHORT RUN UNRESTRICTED MODEL

Let the production function in each sector be of the Cobb-Douglas CRS form, with no technological change:

Tradables sector

$$X_t = K_t^{\alpha} L_t^{\beta} \qquad (\alpha + \beta = 1) \tag{1}$$

Non-tradables sector

$$X_{nt} = K_{nt}^{\gamma} L_{nt}^{\delta} \qquad (\gamma + \delta = 1) \tag{2}$$

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By definition, sectoral capital stocks are fixed in the short-run, so that proportional changes (denoted by the notation $\hat{x} = \dfrac{dx}{x}$) in sectoral outputs can be expressed as:

$$\hat{X}_t = \beta \hat{L}_t \tag{3}$$

$$\hat{X}_{nt} = \delta \hat{L}_{nt} \tag{4}$$

Given that the price of tradables (P_t) is fixed by assumption, and given the nominal wage indexation mechanism (see section 2 in the text), the percentage changes in sectoral labor demands ($\hat{L}_t$ and $\hat{L}_{nt}$), based on own-sector real wages, are a function of the price of non-tradables (P_{nt}) alone. It can be shown that these demands are equal to:

$$\hat{L}_{nt} = \frac{\theta P_t}{\gamma P} \hat{P}_{nt} \qquad \text{with } P = \theta P_t + (1-\theta)P_{nt} \tag{5}$$

$$\hat{L}_t = -\frac{(1-\theta)P_{nt}}{\alpha P} \hat{P}_{nt} \tag{6}$$

Substituting for $\hat{L}_t$ and $\hat{L}_{nt}$ in equations (3) and (4) yields the following expressions for sectoral outputs changes in the short-run:

$$\hat{X}_{nt} = \frac{\delta \theta P_t}{\gamma P} \hat{P}_{nt} \tag{7}$$

$$\hat{X}_t = -\frac{\beta(1-\theta)P_{nt}}{\alpha P} \hat{P}_{nt} \tag{8}$$

Next, we define real GDP in the economy in terms of the numéraire good, T (hence $P_t = 1$), as:

$$Y = X_t + \frac{P_{nt}}{P_t} X_{nt} \tag{9}$$

Or, in terms of proportional changes and output shares:

$$\hat{Y} = \lambda\hat{X}_t + (1-\lambda)\hat{X}_{nt} + (1-\lambda)\hat{P}_{nt} \qquad \text{with } \frac{X_t}{Y} = \lambda \text{ and } \frac{P_{nt}X_{nt}}{P_tY} = (1-\lambda) \tag{10}$$

Assuming that, prior to the injection of aid, the absorption of non-tradables (C_{nt}) is a function of real GDP in terms of good T (namely, Y), and the relative price of non-tradables ($\frac{P_{nt}}{P_t}$), it is possible to write that:

$$C_{nt} = f(Y, \frac{P_{nt}}{P_t}) \qquad f_y > 0 \qquad f_{(P_{nt}/P_t)} < 0 \tag{11}$$

Or, in terms of elasticities:

$$\hat{C}_{nt} = \eta\hat{Y} + \varepsilon_{nt}\left[\widehat{\frac{P_{nt}}{P_t}}\right] \tag{12}$$

Since P_t is fixed by definition, equation (12) is equivalent to:

$$\hat{C}_{nt} = \eta\hat{Y} + \varepsilon_{nt}\hat{P}_{nt} \tag{13}$$

Now, let an inflow of aid, equal to $\frac{F}{P_t}$ in terms of the numéraire, be received. Assuming that this aid consists of an untied grant and, further, that a fraction σ of that grant is spent on NT goods, the proportional change in C_{nt} becomes:

$$\hat{C}_{nt} = \eta\hat{Y} + \varepsilon_{nt}\hat{P}_{nt} + \frac{\sigma F}{P_tC_{nt}} \tag{14}$$

It is now possible to specify the complete general equilibrium (GE) model describing the short-run unrestricted model as a system of 4 equations and one equilibrium condition.

Supply equations (from equations 7 and 8):

$$\hat{X}_{nt} = \frac{\delta\theta P_t}{\gamma P}\hat{P}_{nt} \tag{15}$$

$$\hat{X}_t = -\frac{\beta(1-\theta)P_{nt}}{\alpha P}\hat{P}_{nt} \tag{16}$$

Absorption equation (from equation 14):

$$\hat{C}_{nt} = \eta\hat{Y} + \varepsilon_{nt}\hat{P}_{nt} + \frac{\sigma F}{P_t C_{nt}} \tag{17}$$

Income equation (from equation 10):

$$\hat{Y} = \lambda\hat{X}_t + (1-\lambda)\hat{X}_{nt} + (1-\lambda)\hat{P}_{nt} \tag{18}$$

Equilibrium condition:

$$\hat{X}_{nt} = \hat{C}_{nt} \tag{19}$$

Endogenous variables appearing in this system are $\hat{X}_t, \hat{X}_{nt}, \hat{P}_{nt}, \hat{C}_{nt}, \hat{Y}$. Pre-determined variables are the initial values of P_t, P_{nt}, λ, and C_{nt}. The only exogenous variable is F. After re-arranging, this system can be expressed in matrix notation as:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & -\frac{\delta\theta P_t}{\gamma P} \\ 0 & 1 & 0 & 0 & \frac{\beta(1-\theta)P_{nt}}{\alpha P} \\ 0 & 0 & 1 & -\eta & -\varepsilon_{nt} \\ -(1-\lambda) & -\lambda & 0 & 1 & -(1-\lambda) \\ 1 & 0 & -1 & 0 & 0 \end{bmatrix} \cdot \begin{bmatrix} \hat{X}_{nt} \\ \hat{X}_t \\ \hat{C}_{nt} \\ \hat{Y} \\ \hat{P}_{nt} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ \frac{\sigma F}{P_t C_{nt}} \\ 0 \\ 0 \end{bmatrix} \tag{M1}$$

Solving using Cramer's Rule, it can be shown that the solution for $\hat{P}_{nt}$ is given by the following ratio of determinants:

$$\hat{P}_{nt}^{*} = \begin{vmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & -\eta & \dfrac{\sigma F}{P_t C_{nt}} \\ -(1-\lambda) & -\lambda & 0 & 1 & 0 \\ 1 & 0 & -1 & 0 & 0 \end{vmatrix} \div \begin{vmatrix} 1 & 0 & 0 & 0 & -\dfrac{\delta\theta P_t}{\gamma P} \\ 0 & 1 & 0 & 0 & \dfrac{\beta(1-\theta)P_{nt}}{\alpha P} \\ 0 & 0 & 1 & -\eta & -\varepsilon_{nt} \\ -(1-\lambda) & -\lambda & 0 & 1 & -(1-\lambda) \\ 1 & 0 & -1 & 0 & 0 \end{vmatrix}$$

$$= \frac{\sigma F}{P_t C_{nt}\left\{ \dfrac{\delta\theta P_t}{\gamma P}[1-\eta(1-\lambda)] + \dfrac{\eta\lambda\beta(1-\theta)P_{nt}}{\alpha P} - \eta(1-\lambda) - \varepsilon_{nt}\right\}} \tag{20}$$

Once $\hat{P}_{nt}$ is known, the other variables can be inferred by substitution (not shown).

A2.2 LONG RUN UNRESTRICTED MODEL

In the long-run, sectoral capital stocks can vary, which implies the following sectoral output change equations:

$$\hat{X}_t = \alpha\hat{K}_t + \beta\hat{L}_t \tag{21}$$

and

$$\hat{X}_{nt} = \gamma\hat{K}_{nt} + \delta\hat{L}_{nt} \tag{22}$$

It can be shown that sectoral demands for labor will be a function of the proportional change in sectoral capital stocks and of the percentage change in the price of non-tradables. Thus:

$$\hat{L}_t = \hat{K}_t - \frac{(1-\theta)P_{nt}}{\alpha P}\hat{P}_{nt} \tag{23}$$

$$\hat{L}_{nt} = \hat{K}_{nt} + \frac{\theta P_t}{\gamma P}\hat{P}_{nt} \tag{24}$$

This, in turn, implies the following expressions for sectoral outputs (from equations 21 and 22, and given CRS):

$$\hat{X}_t = \hat{K}_t - \frac{\beta(1-\theta)P_{nt}}{\alpha P}\hat{P}_{nt} \tag{25}$$

$$\hat{X}_{nt} = \hat{K}_{nt} + \frac{\delta\theta P_t}{\gamma P}\hat{P}_{nt} \tag{26}$$

Combining equations (25) and (26) with the existing equations describing absorption of non-tradables, real GDP and the equilibrium condition (equations 17, 18 and 19 in this appendix), we can form the GE system of equations describing the LR equilibrium in the unrestricted model. Expressing this system in matrix notation, we have, after re-arranging:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & -\dfrac{\delta\theta P_t}{\gamma P} \\ 0 & 1 & 0 & 0 & \dfrac{\beta(1-\theta)P_{nt}}{\alpha P} \\ 0 & 0 & 1 & -\eta & -\varepsilon_{nt} \\ -(1-\lambda) & -\lambda & 0 & 1 & -(1-\lambda) \\ 1 & 0 & -1 & 0 & 0 \end{bmatrix} \cdot \begin{bmatrix} \hat{X}_{nt} \\ \hat{X}_t \\ \hat{C}_{nt} \\ \hat{Y} \\ \hat{P}_{nt} \end{bmatrix} = \begin{bmatrix} \hat{K}_{nt} \\ \hat{K}_t \\ 0 \\ 0 \\ 0 \end{bmatrix} \tag{M2}$$

Endogenous variables appearing in this system are $\hat{X}_t, \hat{X}_{nt}, \hat{P}_{nt}, \hat{C}_{nt}, \hat{Y}$. Pre-determined variables are the initial values of P_t, P_{nt}, λ, and C_{nt}. Exogenous variables are $\hat{K}_t$ and $\hat{K}_{nt}$. Solving using Cramer's Rule, it can be shown that the solution for $\hat{P}_{nt}$ equals:

$$\hat{P}_{nt}^* = \begin{vmatrix} 1 & 0 & 0 & 0 & \hat{K}_t \\ 0 & 1 & 0 & 0 & \hat{K}_{nt} \\ 0 & 0 & 1 & -\eta & 0 \\ -(1-\lambda) & -\lambda & 0 & 1 & 0 \\ 1 & 0 & -1 & 0 & 0 \end{vmatrix} \div \begin{vmatrix} 1 & 0 & 0 & 0 & -\dfrac{\delta\theta P_t}{\gamma P} \\ 0 & 1 & 0 & 0 & \dfrac{\beta(1-\theta)P_{nt}}{\alpha P} \\ 0 & 0 & 1 & -\eta & -\varepsilon_{nt} \\ -(1-\lambda) & -\lambda & 0 & 1 & -(1-\lambda) \\ 1 & 0 & -1 & 0 & 0 \end{vmatrix}$$

$$= \frac{\eta\lambda\hat{K}_t - [1+\eta\lambda-\eta]\hat{K}_{nt}}{\left\{\dfrac{\delta\theta P_t}{\gamma P}[1-\eta(1-\lambda)] + \dfrac{\eta\lambda\beta(1-\theta)P_{nt}}{\alpha P} - \eta(1-\lambda) - \varepsilon_{nt}\right\}} \tag{27}$$

The remaining solutions can be similarly derived using Cramer's Rule or by substituting the value of $\hat{P}_{nt}$ into the remaining equations (not shown).

A2.3 SHORT-RUN RESTRICTED MODEL

The labor demand and sectoral output functions of the non-tradables sector are identical to those obtained for the short-run unrestricted model (see appendix A2.1). We therefore have:

$$\hat{L}_{nt} = \frac{\theta P_t}{\gamma P} \hat{P}_{nt} \tag{28}$$

$$\hat{X}_{nt} = \frac{\delta \theta P_t}{\gamma P} \hat{P}_{nt} \tag{29}$$

Given the Harris-Todaro migration process assumed, the nominal wage faced by the tradables sector is:

$$W_t = \frac{L_{nt}}{L_u} W_{nt} \qquad\qquad \text{with } L_u = \text{urban labor force} \tag{30}$$

Or, in proportional change terms:

$$\hat{W}_t = \hat{L}_{nt} - \hat{L}_u + \hat{W}_{nt} \tag{31}$$

By definition, $L_u = \overline{L} - L_t$ with $\overline{L} = $ total labor force   (32)

Or, in proportional change terms:

$$\hat{L}_u = -\frac{L_t}{(\overline{L} - L_t)} \hat{L}_t \tag{33}$$

Given the wage indexation equation (see equation (3) in the text), the following expression for W_{nt} can be derived:

$$W_{nt} = \overline{w}(1-\theta)P_{nt} \tag{34}$$

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Or, in proportional change terms:

$$\hat{W}_{nt} = \frac{(1-\theta)P_{nt}}{P}\hat{P}_{nt} \qquad (35)$$

Substituting equations (28), (33) and (35) into equation (31) yields an expression for the proportional change in the nominal wage of sector T:

$$\hat{W}_t = \frac{\theta Pt}{\gamma P}\hat{P}_{nt} + \frac{L_t}{(\bar{L}-L_t)}\hat{L}_t + \frac{(1-\theta)P_{nt}}{P}\hat{P}_{nt} \qquad (36)$$

Given that P_t is constant by definition, the proportional change in the nominal and own-sector real wages in sector T are identical, which means that this sector's demand for labor can be expressed as:

$$\hat{L}_t = -\frac{\hat{W}_t}{\alpha} \qquad (37)$$

Substituting for $\hat{W}_t$ in equation (36), re-arranging and simplifying yields an expression for the demand for labor in sector T as a function of $\hat{P}_{nt}$ alone:

$$\hat{L}_t = -\left[\frac{\bar{L}-L_t}{\alpha\bar{L}+\beta L_t}\right]\left[\frac{\theta P_t + \gamma(1-\theta)P_{nt}}{\gamma P}\right]\hat{P}_{nt} \qquad (38)$$

which, in turn, yields the following short-run supply function (by analogy with equation (3) in this appendix):

$$\hat{X}_t = -\left[\frac{\beta\bar{L}-\beta L_t}{\alpha\bar{L}+\beta L_t}\right]\left[\frac{\theta P_t + \gamma(1-\theta)P_{nt}}{\gamma P}\right]\hat{P}_{nt} \qquad (39)$$

or, letting $\left[\dfrac{\beta\bar{L}-\beta L_t}{\alpha\bar{L}+\beta L_t}\right] = R$ (a constant):

$$\hat{X}_t = -R\left[\frac{\theta P_t + \gamma(1-\theta)P_{nt}}{\gamma CPI}\right]\hat{P}_{nt} \qquad (40)$$

Combining equations (17), (18), (19) with equations (29) and (40), we can form the GE system of equations describing the SR equilibrium in the unrestricted model. Expressing this system in matrix notation, we have, after re-arranging:

$$
\begin{bmatrix}
1 & 0 & 0 & 0 & -\dfrac{\delta\theta P_t}{\gamma P} \\[2ex]
0 & 1 & 0 & 0 & R\left[\dfrac{\theta P_t + \gamma(1-\theta)P_{nt}}{\gamma P}\right] \\[2ex]
0 & 0 & 1 & -\eta & -\varepsilon_{nt} \\[1ex]
-(1-\lambda) & -\lambda & 0 & 1 & -(1-\lambda) \\[1ex]
1 & 0 & -1 & 0 & 0
\end{bmatrix}
\cdot
\begin{bmatrix}
\hat{X}_{nt} \\[1ex]
\hat{X}_t \\[1ex]
\hat{C}_{nt} \\[1ex]
\hat{Y} \\[1ex]
\hat{P}_{nt}
\end{bmatrix}
=
\begin{bmatrix}
0 \\[1ex]
0 \\[1ex]
\dfrac{\sigma F}{P_t C_{nt}} \\[1ex]
0 \\[1ex]
0
\end{bmatrix}
\tag{M3}
$$

Endogenous variables appearing in this system are $\hat{X}_t, \hat{X}_{nt}, \hat{P}_{nt}, \hat{C}_{nt}, \hat{Y}$. Pre-determined variables are the values of $\overline{L}$, L_t, P_t, and P_{nt}. The only exogenous variable is F. The system can be solved for $\hat{P}_{nt}$, using Cramer's Rule:

$$
\hat{P}_{nt}^* =
\begin{vmatrix}
1 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 \\
0 & 0 & 1 & -\eta & \dfrac{\sigma F}{P_t C_{nt}} \\
-(1-\lambda) & -\lambda & 0 & 1 & 0 \\
1 & 0 & -1 & 0 & 0
\end{vmatrix}
\div
\begin{vmatrix}
1 & 0 & 0 & 0 & -\dfrac{\delta\theta P_t}{\gamma CPI} \\
0 & 1 & 0 & 0 & R\left[\dfrac{\theta P_t + \gamma(1-\theta)P_{nt}}{\gamma CPI}\right] \\
0 & 0 & 1 & -\eta & -\varepsilon_{nt} \\
-(1-\lambda) & -\lambda & 0 & 1 & -(1-\lambda) \\
1 & 0 & -1 & 0 & 0
\end{vmatrix}
$$

$$
= \dfrac{\sigma F}{P_t C_{nt}\left\{\dfrac{\delta\theta P_t}{\gamma P}\left[1-\eta(1-\lambda)\right]+\eta\lambda R\left[\dfrac{\theta P_t + \gamma(1-\theta)P_{nt}}{\gamma P}\right]-\eta(1-\lambda)-\varepsilon_{nt}\right\}}
\tag{41}
$$

The solutions for the other unknowns can be derived by substitution (not shown).

A2.4 LONG-RUN RESTRICTED MODEL

In the long-run, capital stocks in both sectors become variable. In the non-tradables sector, proportional changes in labor demand and output are identical to those for the unrestricted model. Thus, by analogy with equations (24) and (26) in this appendix, we have:

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$$\hat{L}_{nt} = \hat{K}_{nt} + \frac{\theta P_t}{\gamma P} \hat{P}_{nt} \tag{42}$$

$$\hat{X}_{nt} = \hat{K}_{nt} + \frac{\delta\theta P_t}{\gamma P} \hat{P}_{nt} \tag{43}$$

In the tradables sector, equivalent changes are:

$$\hat{L}_t = \hat{K}_t - \frac{\hat{W}_t}{\alpha} \tag{44}$$

$$\hat{X}_t = \hat{K}_t - \frac{\beta\hat{W}_t}{\alpha} \tag{45}$$

That is, labor demand and supply changes are a function of changes in the own-sector nominal wage rate, itself a function of $\hat{K}_t$, $\hat{K}_{nt}$ and $\hat{P}_{nt}$. Recalling from equation (31) that:

$$\hat{W}_t = \hat{L}_{nt} - \hat{L}_u + \hat{W}_{nt} \tag{46}$$

we substitute for the terms on the right hand side using equations (33), (35), (42) and (44):

$$\hat{W}_t = \hat{K}_{nt} + \frac{\theta P_t}{\gamma P} \hat{P}_{nt} + \frac{L_t}{(\overline{L} - L_t)}(\hat{K}_t - \frac{\hat{W}_t}{\alpha}) + \frac{(1-\theta)P_{nt}}{P} \hat{P}_{nt} \tag{47}$$

which can be simplified to:

$$\hat{W}_t = -\left[\frac{\alpha\overline{L} - \alpha L_t}{\alpha\overline{L} + \beta L_t}\right]\left\{\hat{K}_{nt} + \hat{P}_{nt}\left[\frac{\theta P_t + \gamma(1-\theta)P_{nt}}{\gamma P}\right] + \frac{L_t\hat{K}_t}{(\overline{L} - L_t)}\right\} \tag{48}$$

Combining, as before, equations (17), (18), (19) with the new equations (43), (45) and (48), we can form the GE system of equations describing the LR restricted model. In this model, we have kept the equation for $\hat{W}_t$ separate in order to facilitate matrix notation. To that end, we also let

$\left[\frac{\alpha\overline{L} - \alpha L_t}{\alpha\overline{L} + \beta L_t}\right] = S$ (a constant). Thus, the system can be written, after re-arranging:

$$
\begin{bmatrix}
1 & 0 & 0 & 0 & 0 & -\dfrac{\delta\theta P_t}{\gamma P} \\[2mm]
0 & 1 & \dfrac{\beta}{\alpha} & 0 & 0 & 0 \\[2mm]
0 & 0 & 1 & 0 & 0 & -S\left[\dfrac{\theta P_t + \gamma(1-\theta)P_{nt}}{\gamma P}\right] \\[2mm]
0 & 0 & 0 & 1 & -\eta & -\varepsilon_{nt} \\[2mm]
-(1-\lambda) & -\lambda & 0 & 0 & 1 & -(1-\lambda) \\[2mm]
1 & 0 & 0 & -1 & 0 & 0
\end{bmatrix}
\begin{bmatrix}
\hat{X}_{nt} \\[1mm]
\hat{X}_t \\[1mm]
\hat{W}_t \\[1mm]
\hat{C}_{nt} \\[1mm]
\hat{Y} \\[1mm]
\hat{P}_{nt}
\end{bmatrix}
=
\begin{bmatrix}
\hat{K}_{nt} \\[1mm]
\hat{K}_t \\[1mm]
S\hat{K}_{nt} + \dfrac{SL_t}{(\overline{L}-L_t)} \\[1mm]
0 \\[1mm]
0 \\[1mm]
0
\end{bmatrix}
\qquad\text{(M4)}
$$

In this system, endogenous variables are $\hat{X}_t, \hat{X}_{nt}, \hat{P}_{nt}, \hat{C}_{nt}, \hat{Y}$. The pre-determined variables are $\overline{L}$,

L_t, P_t, and P_{nt}. The exogenous variables are $\hat{K}_t$, and $\hat{K}_{nt}$. The system can be solved for $\hat{P}_{nt}^*$, using

Cramer's Rule as before. Thus, P_{nt}^* is equal to:

$$
=\frac{
\begin{vmatrix}
1 & 0 & 0 & 0 & 0 & \hat{K}_{nt} \\
0 & 1 & \dfrac{\beta}{\alpha} & 0 & 0 & \hat{K}_t \\
0 & 0 & 1 & 0 & 0 & S\hat{K}_{nt} + \dfrac{SL_t}{(\overline{L}-L_t)} \\
0 & 0 & 0 & 1 & -\eta & 0 \\
-(1-\lambda) & -\lambda & 0 & 0 & 1 & 0 \\
1 & 0 & 0 & -1 & 0 & 0
\end{vmatrix}
}{
\begin{vmatrix}
1 & 0 & 0 & 0 & 0 & -\dfrac{\delta\theta P_t}{\gamma P} \\
0 & 1 & \dfrac{\beta}{\alpha} & 0 & 0 & 0 \\
0 & 0 & 1 & 0 & 0 & -S\left[\dfrac{\theta P_t + \gamma(1-\theta)P_{nt}}{\gamma P}\right] \\
0 & 0 & 0 & 1 & -\eta & -\varepsilon_{nt} \\
-(1-\lambda) & -\lambda & 0 & 0 & 1 & -(1-\lambda) \\
1 & 0 & 0 & -1 & 0 & 0
\end{vmatrix}
}
$$

$$
=\frac{
\eta\lambda\left[1-\left(\dfrac{\beta L_t}{\alpha\overline{L}+\beta L_t}\right)\right]\hat{K}_t - \left[1+\eta\lambda(1+S)-\eta\right]\hat{K}_{nt}
}{
\left\{\dfrac{\delta\theta P_t}{\gamma P}\left[1-\eta(1-\lambda)\right] + \eta\lambda S\left[\dfrac{\theta P_t + \gamma(1-\theta)P_{nt}}{\gamma P}\right] - \eta(1-\lambda) - \varepsilon_{nt}\right\}
}
\qquad\text{(49)}
$$

From this solution, all the other solutions can be inferred by substitution (not shown).

---

[i] Kiribati's average growth rate of real GDP per capita between 1983 and 1993 was minus 1.2 per cent p.a. (Asian Development Bank 1996: Appendix).

[ii] Symptomatic of that crisis, public sector employment was to be progressively reduced by 60 per cent, beginning in 1996, and the salaries of remaining employees were to be cut by 60 per cent also (Mellor 1997).

[iii] This is true of the five original MIRAB countries (Cook Islands, Kiribati, Tuvalu, Niue, Tokelau). It is also true in practice of other South Pacific countries whose currencies rely on a fixed parity with a metropolitan currency; eg New Caledonia and French Polynesia's currency (the French Pacific Franc) is pegged to the French Franc (through the Euro). While a devaluation similar to that undergone by the French African Franc in recent times is a technical possibility, the parity has not changed in more than twenty years.

[iv] Three MIRAB countries, Tokelau, Niue, and the Cook Islands enjoy this degree of access vis-à-vis New Zealand.

[v] Understandably, the relatively labor-intensive sector will respond more strongly, in terms of employment and output, to a change in its own-sector real wage. Given the Cobb-Douglas production functions postulated here, the real wage elasticity of the sectoral demand for labor is equal to the reciprocal of the income share of capital and hence greater than unity.

[vi] The small country assumption rules out any supply-demand imbalance in the market for T goods causing a change in P_t. The imbalance will be eliminated by a change in exports or imports.

[vii] Cook and Kirkpatrick (1998) argue that urban unemployment is also a possibility in countries with unfettered access to a metropolitan labor market, such as the Federated States of Micronesia (vis-à-vis the US labor market). Their argument rests upon the premise that wages in the public sector are higher than the external wage that would-be migrants can expect, should they leave the country.