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d by Euan Fleming and Brian Hardaker

ATIONAL CENTRE FOR DEVELOPMENT STUDIES
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Abbreviations

ABARE	Australian Bureau of Agricultural and Resource Economics
ADF	Augmented Dickey-Fuller
AusAid	Australian International Development Assistance Bureau
AIC	Akaike Information Criterion
AIDS	Almost Ideal Demand System
BCA	Benefit Cost Analysis
CA	Comparative Advantage
CC	Cash Cropping
CCP	Cash Crop Production
CIC	Coffee Industry Corporation
CM	Competitiveness intraditional primary exports
CPC	Commonwealth Development Corporation
CPI	Consumer Price Index
DAL	Department of Agriculture & Livestock
DRC	Domestic Resource Cost
DV	Diversificationof Primary Export Commodities
EPC	Effective Protection Coefficient
ERP	Effective rate of Protection
EXP	total exports
FEDA	Forecast Error Decompostition Analysis
FG	Food Gardening
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
HA	Household Assets
HE	Household Expenses
HI	Non-labour income
HS	Household Size
ICA	International Coffee Agreement
IFPRI	International Food Policy Research Institute
IMF	International Monetary Fund
IRA	Impulse Response Analysis
ISA	International Sugar Agreement

NPC	Nominal Protection Coefficient
NSO	National Statistical Office
NRP	Nominal Rate of Protection
NSP	Net Social Profitability
OER	Official Exchange Rate
OFG	Other Females in Household
OLS	Ordinary Least Squares
OW	Outside Work
PAM	Policy Analysis Matrix
PC	Park & Choi Test
POC	Park-Ouliaris-Choi
PP	Phillips & Perron Test
PNG	Papua New Guinea
RSL	Ramu Sugar Limited
SC	Schwarz Criterion
SP2	South Pacific Smallholder Project
SPP	Subsidy Ratio to Producers
VAR	Autoregressive Models
WA	Women's Age
WD	World Demand
WH	Work Based at Home
WR	Wage Rate

The economics of food import substitution in Papua New Guinea

John Gibson

In 1985 Papua New Guinea's tree crop exports were worth two times the cost of food imports. By 1991 they could pay only 91 per cent of the cost of food imports, with a slight improvement to parity in 1992. Even before this change in the agricultural trade balance, policy makers believed that food imports were rising rapidly and that increased local food production was urgently required (Shaw 1985). Increased food self-sufficiency also became politically popular because it was believed that this would provide more jobs, easing an urban unemployment problem. These changing priorities are reflected in institutional priorities. The establishment of tree crop industry corporations is meant to free the Department of Agriculture and Livestock (DAL) to focus on food crops, in contrast to previous years when export crops were emphasised. The newly established National Agricultural Research Institute should be an impetus to further emphasis on food crop production.

Although there are some benefits in emphasising food crops, many of the assumptions behind the switch to food import substitution appear to be ungrounded. First, the evidence of falling per capita food production is tenuous. Second, and subject to caveats, it is difficult to find evidence in aggregate data that real per capita expenditure on food imports is rising. Similarly, household budget studies, although limited to two urban areas, provide only mixed evidence for the hypothesis of rising import dependence. What is apparent, in both aggregate and household level studies, is the distorting effect of domestic trade policy.

There are serious economic problems with food import-substitution as currently practised in Papua New Guinea. Concentration on replacement of major imports such as poultry, sugar and rice has caused the diversification of agriculture towards low-value crops. The taxing effect

that higher food prices have on agricultural exporters also reduces foreign exchange earnings and agricultural labour demand. The swing toward increased food self-sufficiency also runs the risk of making Papua New Guinea poorer by promoting uneconomic food processing industries, propped up by forcing consumers to pay high prices.

The policy background

Domestic poultry, tinned meat and tinned fish industries are protected by either import bans or prohibitive tariffs. All three of these industries rely heavily on imported inputs, with the last two simply carrying out 'final assembly' operations. The local beef industry has been protected with occasional import bans, particularly into ports serving mining camps. A proposal at the time of writing aims to restrict beef and sheepmeat imports to carcase form, so that a local boning industry will be established.

Government policy also aims to alter sources of calorie supply. Imported rice is the major source of purchased calories, supplying approximately 40 per cent of dietary energy for urban residents (per capita consumption of approximately 70 kg a head annually). A target of replacing 40 per cent of rice imports (current total of 130 000 tonnes) with locally produced rice and root crops has been set for the end of the decade. Even with subsidised prices, current rice output is less than 1000 tonnes. An import-substitution sugar industry was established in 1983, behind an import ban, and has resulted in retail prices being approximately twice as high as they would have been from imported supplies (Gibson 1993a).

The main food crops (cooking banana, sweet potato, cassava, taro) and stimulants (betel nut) receive little policy attention, in part because they are produced and marketed by an informal sector that allows few direct points for government intervention. Nevertheless, government policy has important side-effects. For example, Highlands coffee growers are a major source of domestically marketed food, especially the temperate vegetables that are increasingly prevalent in urban markets (imports of which are controlled by a flexibly applied quota). Diversification into cash vegetable farming has been prompted by low world prices for coffee, but this effect is now muted by government subsidies for coffee growers.

Local food supply

No one knows how much food is produced in Papua New Guinea. Unfortunately that fact has not stopped people, including reputable economists such as Jarrett and Anderson (1989), claiming that per capita food production is falling. The reference point is the 1961/62 Census of Indigenous Agriculture which, it is almost never noted (cf. Allen 1987), used only a one per cent sample and estimated major food crop production with large standard errors (over 25 per cent). Those estimates have been updated every year by assuming that subsistence production grows in some proportion to population.

Thus, FAO statistics (based on DAL estimates) say that indigenous pigmeat production has grown by 2.69 per cent per annum since 1961, cassava production by 2.70 per cent, bananas by 1.94 per cent, but sweet potato by only 1.72 per cent per annum (how is it that the pigs have grown so well?). This is all nonsense, and it is nonsense that will not be cured by taking another census. Measuring root crop production is hard, especially with intercropping and scattered garden plots. Even if it were known how much food was produced, it would not help policy except to say whether the change in emphasis to food production was appropriate. The most likely policy levers to alter local food production act via consumption effects: changing prices or availability of imported foods. Thus, measuring rural household consumption is more useful than measuring production and, combined with nutritional measurements and data on imports, allows inferences to be made about local production as a residual.

Another approach is to study food prices in urban areas, reasoning that changes in local food supply may cause changes in prices. Joughin and Kalit (1987) found rising relative prices for locally produced foods over the 1971-84 period, possibly supporting the claim that national food production was not keeping pace with demand. However, the large marketing costs and low level of integration between markets makes interpretation of results from this method tenuous. Moreover, the trend reversed in the late 1980s, with imported food prices rising faster than local food prices (Fereday 1993).

It is also possible to make inferences about national food production by reviewing village-level studies. Shaw (1985) and Hide, Allen and Bourke (1992) provide balanced assessments. Shaw suggested that per head food production may have decreased, but not greatly, and highlighted reasons why cash cropping need not lead to decreased food production or intake. After reviewing nutritional data, Hide et al. tentatively concluded that local agricultural systems have been successful in meeting the demands of increased population and economic development. Factors contributing to this success—expansion onto unused land, adoption of new crops and varieties, and out-migration from low productivity areas—may be limited, so continued increases in food intake need not hold into the future. Shaw and Hide et al. also noted the positive impact that cash cropping and access to purchased foods has had on nutrition, especially for children.

Food imports

The evidence on the agricultural trade balance, although motivating food import-substitution policies, has no relevance to the question of increasing reliance on food imports. The reduced purchasing power of agricultural exports is due just to the fall in world prices for tree crops. Comparing food imports with total imports might seem to be more reliable evidence. The facts here are that between 1985 and 1990 food was between 15 and 17 per cent of total import value. This can be compared with an average of 19 per cent over the 1968-83 period (Shaw 1985) and an average of 24 per cent in the 1956-58 period. By this measure, food import dependence is not increasing. However, this measure is sensitive to the level of total imports which is affected by investment requirements for mining projects, so it could also mislead. Further, it is sometimes argued that non-food imports are 'essential items', whereas food can be produced at home so there should be no food imports at all.

A better indicator might seem to be the quantity of imported food consumed per person, whether estimated using national level averages, or even better, from individual observations. There are two problems. Several important foods that are or were imported (rice, sugar, tinned meat, wheat) have falling terms of trade against the main export crops, especially coffee and cocoa (Gibson 1992). Hence smallholders can command an increased quantity of these foods for the same effort by growing tree crops. So rising consumption of these foods is good, not

bad. The pity of sugar import substitution is that Papua New Guinea was on the gaining side of the world sugar market, but bringing production on-shore reduced the value of the domestic production base. Either sugar producers take falling returns (if local prices follow world prices) or consuming households, who are mainly tree crop producers, pay higher prices and their real rewards for export production fall.

The second problem is that local trade policy might force demand to switch to low value foods. A household might then spend the same amount on imports but the quantity consumed rises. Does this imply increasing import dependence? Not really because the rise in consumption does not reflect any increased preference for imports, being caused, instead, by policy distrotions. Imports of beef and sheepmeat give a good example of policy switching demand to low-value foods. Average consumption of red meat imports from Australia and New Zealand rose from 8kg/hd to 13 kg/hd between 1983 and 1992, yet at the same time, real expenditure on meat imports fell. An import ban onpoultry in 1983 and then on tinned meat in 1986 forced import demand to shift from these relatively expensive meats to beef trimmings, as an imput into the local canneries, and sheepmeat, consumption of which rose from 2.5 kg/hd to 9 kg/hd. Yet because sheepmeat and beef trimmings have low unit values, the total meat import bill was less in real terms in 1992 than in 1983. The impact of trade policy driving a wedge between values and volumes of imports is crucial. If there were no trade policy interventions forcing substitution toward cheaper meats, imports in 1992 would have been 35, 000 tonnes, instead of 49, 000 tonnes (Gibson, 1993b). Per capita consumption of imported meat would only have been 9.5 kg, the same as in 1985.

The most reliable indicator of dependence is the share of household budgets allocated to imported foods. This does not change if favourable terms of trade shifts allow households to command a greater quantity of imports or trade policy distorts demand toward low unit value foods. The appropriate budgets include the imputed value of own food production (in contrast to Sexton (1988) who overstates claims about food import dependence by measuring cash incomes only).

There is a dearth of appropriate survey evidence studying the same households across time. Christie (1980) surveyed households in Yobakogl village at a one-year interval but measured purchases rather than consumption and had such a small sample that standard deviations exceeded average purchases so that, for example, the null hypothesis of zero expenditure on items such as rice could not be rejected. Recurring

nutritional studies within that same village do show a rise in the purchased component of energy and protein intakes (Harvey and Heywood 1983).

Heywood and Hide (1992) summarised a variety of dietary, anthropometric and economic studies to assess the nutritional impact of the switch towards export crop production. They suggested that there was a major increase in the level of consumption of purchased foods in the Highlands after 1970, due to rising incomes associated with the coffee boom. No studies appear to measure changes since the fall in coffee prices after mid-1980s, which is unfortunate because that was a period of increased policy concern about food imports. It is also important for nutritional status, given the observed positive association between cash cropping income and improved growth and nutrition.

The data for urban areas are somewhat better. Although unpublished, budget data from the 1985/86 Urban Household Survey can be compared with estimates from the 1975/76 Household Expenditure Survey to see whether imports captured a larger share of food budgets. Table 1.1 presents estimates of food budget allocations for Port Moresby and Goroka. There are several caveats to making the comparison: (a) the 1975/76 survey occurred within two-month periods in each location whereas the 1985/86 survey was staggered over an entire year to capture seasonal influences, (b) the 1985/86 survey was broader, including non-citizen households and peri-urban areas, (c) the standard deviation for the 1975/76 estimates is not known but will exceed that for 1985/86 because of the smaller sample size, and (d) the 1985/86 results are unofficial and preliminary. Cleaning of the data was conducted by the author rather than by the National Statistical Office.

Table 1.1 shows rather more stability in food consumption patterns, especially for Port Moresby households, than would be expected if the vociferous cries that import dependence is rising were to be believed. In neither Port Moresby nor Goroka is there a statistically significant increase in the share of food budgets spent on the politically sensitive cereals group. However, Goroka households have increased the expenditure share for bread and biscuits. There has been a large reallocation of expenditure within the meats group and also away from meats as a whole. Beef and veal, and poultry have smaller shares of food budgets, as has tinned meat in Port Moresby but not in Goroka. The impact of the poultry import ban may be apparent in these data, as is the consequent rise in sheepmeat consumption (to approximately four per cent of food spending).

The most important local staples—bananas and sweet potato—captured increasing budget shares in Goroka, with mixed results in Port Moresby. The apparent fall in Port Moresby budgets for bananas may reflect seasonal factors: for the 58 households surveyed in September-October 1986, bananas were four per cent of food consumption expenditure, which is the same as in the 1975/76 survey carried out in those same months. Overall root crop dependence fell slightly in Port Moresby, due to a decline in expenditure on taro.

Deciding whether Table 1.1 shows rising import dependence is difficult because of the indirect import content of locally produced foods, especially beef, poultry, sugar and tinned meat. The rising share of takeaways also hides the true picture: most takeaways are probably imported meats (sheep tongues etc.) or flour and fat based (scones), but some are of local origin. Moreover, the table provides a historic picture only; there are no comparable data being collected at the time of writing to assess whether current concern about food imports is appropriate.

However, the table does provide some help. The pattern of Goroka expenditure appeared to be moving towards that in Port Moresby (except for the much higher dependence on root crops), which was itself fairly stable. Where there is instability, it possibly has policy causes, as in the meat expenditures. Thus, new data might look like those for 1985/86, except for the further effects of protecting the tinned meat and tinned fish factories and associated rises in sheepmeat consumption. Another important point is the evidence of substitution effects. Many statements on food policy imply that consumers have a fixed budget allocation that they will not alter and that this is a source of vulnerability to foreign price shocks. Data on Goroka households especially refute this, perhaps because these households have lower incomes than those in Port Moresby and are thus more price sensitive (Timmer 1981) or because they have access to better growing conditions for own food production.

How is it that there are rising imports for an item such as rice, which appears to have a stable budget share? First, total food budgets might increase by more than food prices, so that a constant share still means greater expenditure. Port Moresby food budgets were 55 per cent higher in 1985/86 than in 1975/76, whereas rice prices were only 41 per cent higher, so the same food budget share bought an extra two kg per fortnight for the average household (rising from 16.0 to 17.9 kg). Food budgets and rice prices in Goroka rose at the same rate, so household consumption

Table 1.1 Food consumption patterns in two urban areas in Papua New Guinea: 1975/76 and 1985/86

Food item	Port Moresby 1975/76 (n=176)	Port Moresby 1985/86 (n=339)	Goroka 1975/76 (n=82)	Goroka 1985/86 (n=182)
	%	%	%	%
Bread and biscuits	6.8	7.2	4.3	5.9*
Rice	10.2	10.3	11.3	12.4
Other cereal	5.4	4.0*	4.1	3.2
	21.6	19.7	21.6	22.4
Beef and veal	3.6	1.5*	5.5	2.2*
Lamb and mutton	..	4.4*	..	4.7*
Pork	2.3	1.1*	3.4	1.5*
Poultry	7.9	7.7	12.4	6.5*
Processed and other meats n.e.s	2.0	1.9	3.7	1.0*
Tinned meat (incl. with vegetables)	8.8	6.2*	4.1	7.2*
	24.5	22.9*	29.1	23.1*
Fresh/frozen fish (incl. shellfish)	6.6	8.6	0.3	0.1
Tinned fish	4.1	5.1*	5.2	7.0*
Dried and other fish	0.4	0.1*	0.1	0.0
	11.1	13.8*	5.7	7.2*
Milk: liquid, powdered and evaporated	2.7	1.8*	1.6	2.0
Ice cream, other dairy, and fats & oils	2.7	3.5*	2.1	3.8*
Eggs	0.4	0.5	0.5	0.5
	5.8	5.8	4.3	6.3*
Bananas: cooking, sweet and other	4.3	3.2*	1.2	2.4*
Other fresh fruit	1.6	2.0	2.4	1.8
Fresh vegetables	3.2	3.7	9.1	5.3*
Coconuts and other nuts	1.5	1.5	3.6	1.4*
	10.5	10.3	16.2	10.8*
Sweet potatoes	1.6	1.9	10.2	10.7
Cassava	..	0.5	..	0.7
Taro	1.2	0.4*	0.1	0.5*
Other roots and tubers	1.7	1.0	1.3	0.2*
	4.5	3.8*	11.6	12.0
Take away & restaurant food	11.2	12.0	5.9	8.4*
Sugar	4.9	3.9*	3.4	4.6*
Confectionary, processed & other food	2.9	4.3*	2.7	3.7
Coffee, tea and other food beverages	2.0	1.7	1.4	2.3*
	9.9	9.9	7.5	10.6*
Value of food consumption	K62.76	K96.13	K42.96	K56.89

Notes:
* 1985/86 estimate is more than two standard deviations from comparable 1975/76 estimate.
.. Budget share in 1975/76 was too small for separate mention.

stayed at 11.4 kg per fortnight. However, people moving from rural areas, where rice consumption is low, to urban areas, where it is higher, could account for much of the demand growth. Thus, a good policy to control rice imports is to increase labour demand and incomes in rural areas. As discussed below, export tree crops do a better job of this than would a domestic rice industry.

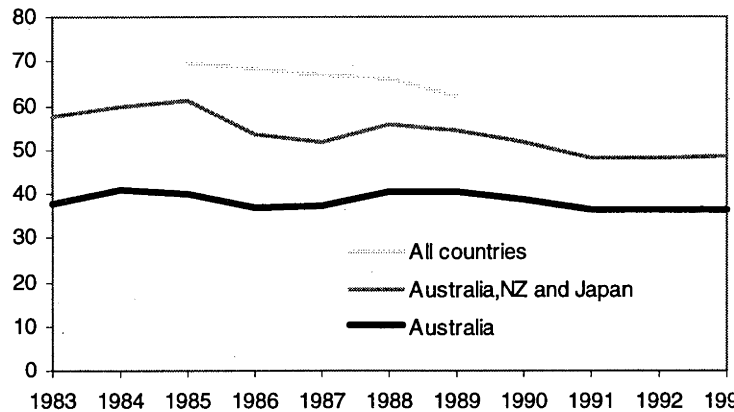
Figure 2.2 gives further evidence about food imports, showing trends in total expenditure, deflated by the local Consumer Price Index and expressed in per capita terms. The National Statistical Office (NSO) data are available only to 1990 so more recent data were also collected on Australian exports to PNG. Australia supplied 70 per cent of PNG's food import value in 1990 so trends in Australian exports will mirror trends in total food imports. There is some discrepancy between the Australian data and the matching NSO data for 1987-90, with the NSO data suggesting that imports were K4 a head lower. Even with this discrepancy, the trend is in the same direction for both sets of data.

Figure 2.2 shows that real per capita expenditure on imported food is falling. In 1985 the average person spent K66 (1992 terms) on imported food and this fell to K58 by 1990. If this expenditure followed the same trend as Australian food exports to PNG, then the average person spent only K51 on imported foods in 1992. Over the 1985-92 period, real private consumption per capita fell slightly (from K437 to K390 in 1983 prices) but the fall in real food import values is greater, causing the food import share to decline from 9.4 to 8.1 per cent of real per capita private consumption.

There are some caveats to this analysis. In 1985 Papua New Guinea imported meat in tins; in 1992 it imported beef trimmings, which are food, and empty tins, which are not. Therefore, some of the fall in expenditure is due to the non-food inputs into recently established food processing industries appearing elsewhere in the import statistics. The civil conflict on Bougainville may cause per capita expenditure to be understated, because the North Solomons are counted in the population denominator but may not have been consuming imported foods due to the blockade. However, even subtracting the North Solomons population estimate (around 160,000) from the denominator after 1989, there is still a downward trend in expenditure, from K66 in 1985 to K61 (cf. K58) in 1990.

Finally, the Australian data give a further illustration of the error of studying import quantities rather than values. The real value of Australian food exports to Papua New Guinea was K126 million in 1992, the same as the

Figure 1.1 Real expenditure on food imports in Papua New Guinea



value in 1985. The quantity of food exports to Papua New Guinea rose from 253, 000 tonne to 328, 000 tonne over the same period, implying that per capita average consumption rose from 75 kg a head to 83 kg a head. The difference is mainly due to the changed composition of meat imports and the falling real price of cereals. One can find growing food import dependence by choosing the most supportive statistic, even if it misleads in terms of economic analysis.

In summary, the evidence presented is not strongly supportive of the hypothesis that food import dependence is increasing. There are many caveats, in part due to the distortions caused by local policy and the shortage of recent household budget studies, but it does seem that the assumptions underlying the policy shift toward food import substitution are unwarranted. There are also sound economic reasons for viewing food imports as more benign than most discussion suggests. Moreover, food import substitution can often produce perverse economic effects, causing more damage than good. These points are discussed below.

An alternative perspective on food imports

One of the main concerns about food imports into Papua New Guinea (Heywood and Hide 1992) and the wider South Pacific (Harris 1984) is that they use foreign exchange that could be better used for other development priorities. There are at least three objections to this concern. First, restricting food imports may in fact reduce foreign exchange supplies because of the need to import inputs into food production and processing, and the reduced export competitiveness if food prices rise (Harris 1984). Empirical estimates of the second effect are considered below.

The second objection to the 'non-essential import' view is that it overlooks the degree to which food imports are investment goods. The evidence summarised by Heywood and Hide (1992) is that consuming rice and tinned fish in rural areas has been associated with improved nutrition, especially for weaning—age children, for whom root crops may not provide a sufficiently dense energy source. Of course far more rice is imported than is needed to feed children but, without heavy interference in intra-household distribution, that extra consumption may be a necessary cost to achieve the benefit of improved childhood nutrition. In economic terms, this improved nutrition translates into more productive human capital formation, producing people with higher work capabilities and ultimately contributing to a lower birth rate.

The third objection is that commentators who argue that there are better uses for foreign exchange may have an overly optimistic view of the priorities of the state and the productivity of non-food imports. Consider four recent policy initiatives of the Papua New Guinea government: the Lae cement and tinned fish factories, the Fairfax Harbour oil refinery and the Burns Peak freeway. It is difficult to see how the imports associated with any of these projects are more productive than food imports. In fact, it is easier to see the harm (higher tinned fish prices, higher transport costs) that these projects impose on people living in villages. Given the tendency for government to concentrate on grandiose urban projects,

and its declining ability to deliver rural services, it might be that rice and tinned fish are the best that people can hope for.

Another concern about food imports, at both household and national levels, is that they increase vulnerability to changed world prices for food (in urban areas) or tree crops (in rural areas). This is especially because food supply is assumed to be inelastic in the short run (Heywood and Hide 1992). The recent evidence of Highlands farmers inter-cropping fruits and vegetables with coffee (Ghodake et al. 1993) suggests that there may be more elastic short-run supply substitution possibilities than previously thought. It is also notable that the availability of cash incomes from export cropping has improved the buffering capacity of the Highlands food system in its response to climatic variability (Bourke 1988).

More fundamentally, the 'increased vulnerability' hypothesis does not necessarily imply import substitution and retreat from the world market as appropriate policies. If the problem is variable prices and reliance on a narrow commodity base, then a logical solution is to advance the transition to cash crops by increasing the range of crops grown, so that incomes are not dependent on the price of just one commodity. For example, Gibson (1994) shows that a farming system with coffee as its only export can expect revenues to fall below one-half of average, one year in fifteen, due to the variability of world coffee prices. However, a farming system producing coffee and honey, even with the same average level of revenues, will see a similar-sized fall in revenues only once every 56 years. Vulnerability is reduced as the cash cropping base gets broader. The goal for policy should be to help farmers have a portfolio of tradeable crops that give the highest overall return and the lowest risk. There is no need to restrict attention just to foods that are imported because that encourages the folly of selecting crops (for example, rice and sugar) whose prices have a long-run tendency to fall against tree crop prices (Gibson 1992).

Finally, it is not clear what the critics of food imports would rather have people spend their money on. More beer and gambling? Given access to cash-earning opportunities, a demand for spending opportunities naturally follows. Until recently, the range of consumption opportunities for village people was limited. Unlike smallholders in other countries, taxation has not been onerous and forced mobilisation of agricultural savings has not occurred. High transaction costs prevent financial intermediation in many areas, so immediate consumption out of earned cash may be one of the most attractive options available.

Economic effects of food import substitution

The general macroeconomic consequences of protected import substitution are well known (Harris 1984). Households have to pay more for goods that were formerly imported and therefore press for higher wages, especially if the protected goods are foods that command a large share of budgets. At the same time, scarce resources (for example, capital) are bid into the protected sector. Export-oriented firms, which are not able to pass costs forward onto world markets, suffer from rising input and wage costs, so they have reduced incentives to produce. The same effects occur when the export firms are smallholder households. The rise in the cost of purchased foods (a fall in their household terms of trade) reduces supply incentives.

The specific size of these effects in Papua New Guinea was studied by Gibson (1993a, 1993c). In the sugar industry, protected import substitution has caused real retail prices to be approximately twice as high as they would have been had Papua New Guinea remained an importer. As well as making the economy worse off by producing at home something that could be more cheaply imported, high sugar prices act as an inequitable tax on poor consumers. The Urban Household Survey data suggest that the poorest 10 per cent of households pay a sugar tax that is equivalent to 3.2 per cent of the value of their consumption; the wealthiest 10 per cent of households pay a tax of only 0.6 per cent.

There are some factors specific to the sugar industry, including droughts, pests and diseases, that may account for this poor performance, so it should not be concluded that all food import substitution attempts will cause prices to double. However, the general presumption is that food prices will rise because: (a) promoting industries by import protection interferes with comparative advantage, and (b) the difficult terrain and low population density raise transport and marketing costs and prevent national economies of scale, making import supply cheaper.

Higher food prices could perhaps be justified if associated employment increases result from the switch to food production. However, it appears that the export tree crop industries, and especially cocoa and coffee, are more labour-intensive than the food import substitution industries. For example, it takes 49 unskilled labour days to grow sufficient tree crops (approximately 450 kg) to exchange for one tonne of rice on the world

market. The commercial rice production models suggested for Papua New Guinea all use less labour to produce one tonne of rice. Domestic production of rice would be a less efficient creator of employment than the present system of using tree crop production and international exchange.

Not only would there be less efficiency in creating jobs, there could actually be a reduction of employment if a domestic rice industry were established under tariff protection. Regression estimates suggest that the volume of tree crop production is related to the terms of trade between tree crops and rice. If a 10 per cent tariff on rice were imposed, causing a decline in the tree crops to rice relative price, tree crop production would fall permanently below trend by 0.8 per cent. With exports approximately 350,000 tonnes, the reduced production would be 3,000 tonnes. As well as a loss of export revenues, there would be a lower demand for labour in tree crop production. The implied employment loss is 300,000 unskilled labour days which would only be offset by a smallholder mechanised rice industry producing at least 7,000 tonnes of rice—more than seven times the level of current rice production. A commercial rice industry would have to produce far more (approximately 60,000 tonnes) to make good the employment loss. These estimates suggest that the likelihood of protected food import-substitution raising overall employment is rather low.

Conclusions

Despite a lack of supporting quantitative evidence, Papua New Guinea's food policy is based on the twin beliefs that (a) per capita food production is falling and (b) the country is becoming increasingly reliant on imported food. The evidence surveyed in this paper challenges these beliefs. The results from existing food import substitution attempts should caution policy makers against further interventions that create inequitable taxes on poor households, reducing agricultural employment and undermining export competitiveness.

Commercialisation of agriculture at Karimui, Papua New Guinea: effects on household production, consumption and the growth of children

Mike Finlayson, John McComb, Brian Hardaker and Peter Heywood

Many governments of developing countries seek to reduce rural poverty and improve rural and national income levels by fostering the commercialisation of agriculture, typically through greater cash cropping. This approach is usually based on implicit assumptions that more cash cropping means higher real incomes, which in turn mean better standards of living, including (at least for poorer families) increased food consumption and improved nutritional status. But these assumptions have been challenged in many countries, including Papua New Guinea. There is a school of thought, quite strong in the South Pacific, that holds that moves away from 'traditional' subsistence diets lead to unfavourable nutritional outcomes (Parkinson 1982; Thaman 1982).

In 1984, the International Food Policy Research Institute (IFPRI) planned a series of studies in several countries designed to investigate these matters. A common set of research protocols was developed to ensure some consistency of approach in the various studies. The study reported here, although independently conceived, involved use of those protocols.

The study was conducted at Karimui, in the south of Simbu Province of Papua New Guinea, where the development of a cardamom estate, starting in 1978, created the opportunity to study the impact of a recent and fairly dramatic shift from semi-subsistence production to increased commercialisation of a rural community. The fact that the commercialisation took the form of estate development with wage employment of the local people appeared to provide a good environment for testing alternative propositions about the nutritional impacts of cash cropping. There is a widely held view that estate development is more likely to prove deleterious to nutrition since estate workers are more likely to become cut off from their subsistence base than are smallholder cash croppers. The contrary view is that a mixed cash and subsistence system provides a good basis for enhancing household food security.

A conceptual framework for the networked investigations has been provided by IFPRI, as outlined in Figure 2.1. An understanding and, where appropriate, quantification of these links can provide a basis for effective interventions to mitigate any undesirable nutritional impacts of the processes of commercialisation.

The specific objectives of the study were to evaluate the extent to which, and to elucidate the processes by which, shifts from the largely subsistence-based smallholder agriculture at Karimui to increased commercialisation through wage employment have affected

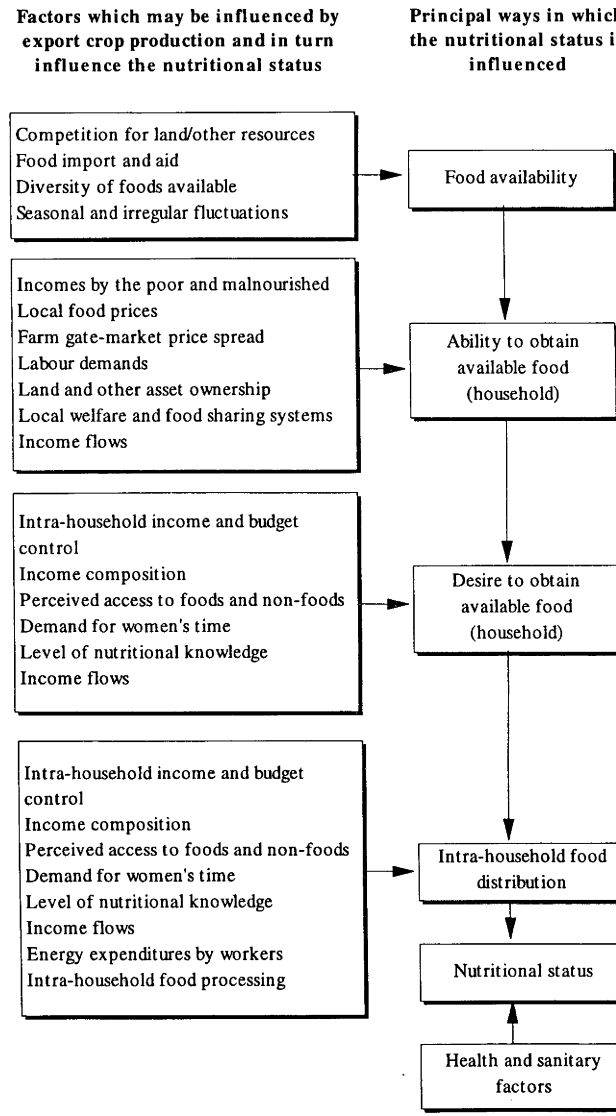
- household production and incomes
- household consumption of food and non-food items
- household food nutrient availability and, ultimately
- nutritional status, particularly of young children.

Karimui: the study site

Karimui is situated on a volcanic plateau in South Simbu. The terrain at the edges of the plateau is rugged and there is no road connection between Karimui and other parts of the Highlands: access is by small plane, or by foot involving a walk of a few days.

About 5000 people live in the sub-district in dispersed hamlets. Although the population density is low by comparison with neighbouring North Simbu, it has increased rapidly in recent years, putting increased pressure on both land and forest resources.

Figure 2.1 **A schematic overview of the relationship between cash cropping and nutritional status in Karimui, Papua New Guinea**



Although nearly three-quarters of the people claim to be Christians, the majority of women are in polygynous unions. Wives are typically younger than their husbands, often markedly so for those married polygynously. Education levels at Karimui are low, especially for women—only about two per cent of women over 20 had received any schooling, compared with almost half the men over 20. Health and nutritional levels are also unsatisfactory. While severe malnutrition of children is rare, about 40 per cent of those under five were found to be moderately malnourished in terms of weight for age, with no evidence of any improvement in recent years (Groos 1988). Moreover, child morbidity (illness) is high, particularly respiratory illnesses, malaria and other fevers. Few children receive the recommended vaccinations and overall childhood mortality is high.

At the time of the study, agriculture at Karimui was bimodal in that semi-subsistence smallholder production existed side by side with a commercial cardamom estate. Households varied in their commitment of time to the two components, but almost all families in the immediate area of the cardamom estate had some involvement in both types of production.

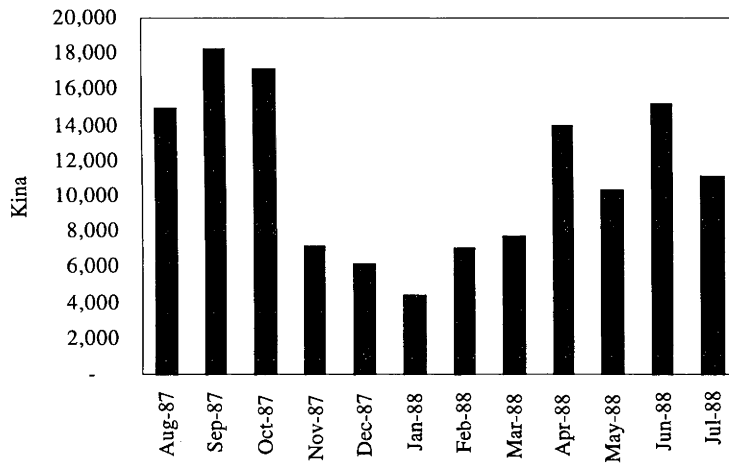
The subsistence agriculture at Karimui is a slash and burn shifting cultivation system. Sweet potato is the main staple grown, but taro, bananas and many other crops are also produced. In addition, the forest itself is an important source of foods and provides many other materials used for clothing, housing, tools and medicinal purposes. Smallholder cash crops include coffee, cardamom and chillies, but areas grown are small and production methods extensive. Some smallholders also sell food crops in local markets.

In the mid—1970s, what later became the Karimui Spice Company was formed as an association between local growers and a commercial arm of the Provincial Government. Estate-scale planting of cardamom began in 1979/80. Despite many set-backs, by the mid 1980s the enterprise had grown to be a major source of employment and cash incomes for most Karimui households (Figure 2.2). Subsequently, the business faltered due to management and associated financing problems, and it later ceased operations.

Theoretical background

A theoretical framework for the micro-level study of the economics of human nutrition is provided by the kinds of integrated farm-household economic models expounded by Singh, Squire and Strauss (1986: Chapter

Figure 2.2 Total wages paid by Karimui spice company in Papua New Guinea



1). In such models the household is assumed to maximise a utility function defined in terms of staple foods, cash goods and leisure. Utility is maximised subject to a set of constraints. First, there are the household production constraints, such as the production functions for farm output and wages. Second, there is a constraint that the totals of cash income and cash expenditure are equal. Third, there is a constraint on the total time available to the household, relative to uses in production, wage employment and leisure. Under assumptions about the existence of effective markets for staple foods and labour, cash and time constraints are often combined into a single 'total income' constraint.

Reduced-form equations can be derived for this constrained optimisation with endogenous variables such as household consumption as dependent variables and exogenous variables such as prices as explanatory variables. The set of explanatory variables may be enlarged to include other variables that are predetermined from the point of view of the household, such as physical, financial and human resource endowments, policies and community characteristics.

Integrated farm-household models are usually estimated assuming that preferences are not considered in income maximisation. However, the optimal income affects the level and pattern of consumption budget

allocation. Production and consumption decisions are then said to be separable and the model can be estimated recursively, analysing production decisions first followed by the consumption choices once the optimal level of profit has been determined.

There are two limitations to this general approach for present purposes. First, the reduced-form model does not permit conclusions to be drawn about the processes through which consumption, and hence nutritional status, is affected by key endogenous and exogenous factors, as outlined in Figure 2.1. The various steps in the process are compressed together in the reduced form models, so that scope for interventions to improve nutritional outcomes are not readily identifiable (Bouis and Haddad 1990a:17).

The second limitation of the recursive model is that the strong assumption of separability may not be justified. Separability depends on the existence of effective markets for both foods and labour, such that households can both buy and sell at the same prices in these markets. Because of the isolation and early stage of commercialisation of the Karimui economy, however, the local markets are poorly developed, with potentially large differences between producer and consumer prices for foodstuffs and limited employment opportunities for surplus family labour at certain times. Separability also depends on an assumption of a riskless world, which events at Karimui in relation to security of employment showed also to be unrealistic.

If the separability assumption is not valid, the relevant prices for econometric estimation are the household-specific shadow prices, which may be unobservable and indeterminate. Indeed, to assume separability in the context of the present study means assuming away the very problem under study, since separability implies that consumption behaviour is independent of the level and source of income (Alderman 1989).

Difficulties in data requirements and estimation for the non-recursive case explain why there are relatively few examples in the literature where separability is not assumed. Particular limited cases of non-separability are to be found (Lopez 1986) but many methodological issues remain to be resolved (Singh, Squire and Strauss 1986: Chapter 3). Meantime, pragmatism seems to be the order of the day. Household models appear to provide a good conceptual framework for the issue under investigation, but offer limited insights into the choice of the best method of analysis in

the absence of separability. Moreover, in the context of this study, analysis was highly constrained by data limitations, explained below. As a result, the modelling work summarised here is seen as a 'first cut' at a problem that has proved much more complex than was conceived when the work began.

Research methods

The study commenced in mid—1987 and was formally terminated at the end of September 1989. The data collection phase ran from April 1987 to August 1988.

Sample selection

Households were chosen as the units for most of the data collection. Information was needed from a sample large and diverse enough to enable a comparison of households with different degrees of participation in the labour market created by the operations of the cardamom estate. At the same time, resources for fieldwork were limited in relation to both the difficult working conditions and comprehensive data needs. It was decided to select an initial sample of 90 households, judged to be the maximum that could be managed with regular monitoring and interaction, while being enough for statistical analysis.

The study was confined to three villages in the Karimui sub-district to limit travelling time between sample households (all done on foot), facilitate supervision of field assistants and promote more effective and helpful social interaction between research workers and sample households. The villages selected were located at different distances from Karimui Spice Company, to give a sample spanning the range of degrees of involvement in wage employment.

Approximately 30 households were selected from each village by a stratified sampling method, with stratification by employment status (casual or permanent employment) and marital status of the household head (monogynous or polygynous). The sampling technique ensured similarity, as far as possible, of the distribution of age and religion of the household head between the sample and population.

Data collected

Information was collected from the sample households on the levels and sources of income, expenditure and consumption patterns, and on nutritional status of household members. At the same time, data were gathered on other factors thought to affect the ability or willingness of household members to engage in wage employment or to influence nutritional status. Data were collected over a period of one year, divided into two six-month intervals, providing the opportunity to observe the impact of variations over time, such as seasonal differences.

Levels of household resources (finance, livestock, food and cash crop garden areas, household items) were measured on three occasions at intervals of about six months. Garden areas were measured directly, while data on other resources were collected by interview, supplemented by direct observation. Anthropometric measurements including weight and height (length for young children) were made for fathers, mothers and children under five years old at the same time as the resource surveys.

Levels of cash income (by source) and cash expenditure (by category) were collected for all households by recall each fortnight for one year. Diets were assessed by recall of foods (by source) eaten in the previous 24 hours on one day in each fortnight. Information on child care was collected with a similar frequency. Morbidity of both mothers and children during the previous fortnight was assessed by recall of the mother.

Subsistence foods (including gifts) were recorded as they were brought to the household each afternoon on six consecutive days on four or five occasions for each household. Measures of subsistence production and consumption have been extrapolated from this rather sparse information. More detailed measurements of household or individual food intakes were not feasible. Nor was it possible to obtain information on time allocation; instead, working household members were asked to recall once per fortnight what activities they had engaged in during the previous 24 hours. Activity frequencies were deduced from these data.

The limited data obtained on time use and food consumption considerably constrain the types of analysis that can be undertaken. However, these limitations were unavoidable given the conditions at Karimui. It was judged to be too intrusive to have attempted to collect data on actual food

consumption and time use. Moreover, much of the information could only have been obtained from women by women enumerators fluent in the local languages; given the educational standards of Karimui women, the female enumerators needed could not have been recruited.

Data collected from other sources included the production, wage rates and wage payments of Karimui Spice Company, and the prices and quantities of smallholder cash crops. Food prices were collected weekly from the two main local markets and monthly from several trade stores. Data were also collected for construction of an index of throughput at the local markets. Outpatient clinic records were collected from the health centre and the aid-posts in the survey villages. Rainfall records were kept at the three villages from July 1987 to August 1988. Information was obtained from Karimui Spice Company on rainfall at Karimui for a five-year period ending August 1988.

Method of analysis

The first step in analysis of the large volume of detailed data gathered was to summarise the characteristics of the surveyed households with respect to resource base, resource utilisation, income and expenditure levels, food availability and consumption, health and welfare of children, and nutritional status of both adults and children. These results are too voluminous to report here: they are given in the published report (Finlayson, McComb, Hardaker and Heywood 1991).

Building on the understanding gained from a review of these summarised data, the analysis was developed by dividing household decision making into a number of stages. These stages are the determination of household income, decisions about household consumption, decisions affecting household availability of nutrients, and determinants of nutritional status of young children. Plans to estimate the relationships at each stage in recursive fashion, as indicated by the broader arrows in the figure, were frustrated by estimation problems and it was necessary to combine stages, as indicated by the narrower arrows, in the search for more reliable results.

This recursive formulation is similar to that used by Bouis and Haddad (1990a) who argue that the approach is legitimate if household decisions are made in such a sequential way, not simultaneously. An assumption of sequential decision making therefore underlies the results described below.

Empirical results

Household income

Food production. The determinants of household income were explored in the first stage of analysis. Regression analysis was used to fit separate production functions for household food production and household production of perennial cash crops, the principal components of farm income. A Cobb-Douglas production function was used to estimate a food production function for sample households. The value of food production was regressed on food garden area, peanut garden area, gardening labour input (frequency) and an index of food tree resources. Food production, food and peanut garden areas and food tree resources were expressed in terms of adult equivalents. Village and period dummy variables were included.

The results, shown in Table 2.1, indicate that peanut area, gardening labour and food tree resources significantly affect the value of food production. The sum of the elasticities of the inputs specified is 0.58, indicating decreasing returns to scale for food production. The elasticity of food production with respect to the frequency of gardening labour implies that a 10 per cent increase in frequency of gardening would increase food production by 1.4 per cent. A 10 per cent increase in the food tree resource index would increase the value of food production by a more substantial 2.5 per cent. It is, of course, generally impossible for households to increase their access to food trees in the short run. Thus, manipulation of this resource does not provide households with a means of meeting any unforeseen shortfall in food availability.

The area of food gardens was not a statistically significant explanator of the value of food production. This somewhat surprising result might be explained in a number of ways. There may be considerable variability in garden productivity, perhaps reflecting factors such as the value and yield of garden species grown, or soil fertility. If variability in productivity exists, it may be that the effective 'size' of a garden is best measured by labour inputs rather than area. Unfortunately, the data on garden labour inputs are too limited to allow more comprehensive analysis of labour productivity. The proposition is supported, however, by the fact that gardening labour frequency, which is an imperfect measure of labour input, is nevertheless significant in the regression.

Table 2.1 Estimation of the factors affecting household food production in Karimui, Papua New Guinea using a Cobb-Douglas production function

Variable	*b* coefficient	*t* statistic
Garden area[b]	0.05	0.5
Peanut area[b]	0.15	3.0
Garden labour[c]	0.14	1.5
Food tree index	0.24	1.6
Village dummy[d]	–0.68	–5.2
Period dummy[e]	–0.37	–3.7
Constant	0.77	1.1
Adjusted R^2	0.49	
Number of observations	95	

[a] Food output per period expressed in kina per adult equivalent per fortnight.
[b] Garden and peanut areas are expressed in hectares per adult equivalent, derived from three garden surveys.
[c] Garden labour represents the frequency that household members (males older than 12 years and females older than 8 years) worked in gardens.
[d] Households from Kilibari village are identified using a zero-one dummy variable (Kilibari = 1).
[e] Period is a zero-one dummy variable (period 1 = 1).

The indication from this analysis, therefore, is that time allocation to gardens, chiefly by women, is a main determinant of food output. Yet, given other responsibilities of women in home-making, child care and cash cropping, it seems likely that wage employment at Karimui Spice Company would compete directly with gardening time. This matter is explored further below.

Cash crop output. A linear equation was estimated for cash crop sales using as independent variables determinants such as the area of mature coffee and cardamom owned, frequency of work in cash crop gardens and level of wage employment. The linear model was chosen in preference to the Cobb-Douglas production function because of the large number of zero values. The linear form was judged to be adequate because the range of output is limited and use of yield-increasing purchased inputs was rare.

Results presented in Table 2.2 indicate that both coffee and cardamom area are significant explanators of cash crop sales. Cash crop labour (expressed as the proportion of days household members worked in cash crop gardens) is also an important explanator of cash crop sales. At the mean, a 10 per cent increase in frequency of cash crop labour would lead to a four per cent increase in cash crop sales. By contrast, 10 per cent increases in coffee and cardamom areas would lead to two and one per cent increases, respectively, in cash crop output (also evaluated at the means of the data).

Observations on cash crop gardens at Karimui indicate that coffee and cardamom crops are not always harvested, presumably because the rewards obtainable are judged not to be worth the labour effort required. The relatively high elasticity for cash crop labour frequency suggests that output would be greater if households were to devote more time to cash cropping, particularly to harvesting. In summary, the model results show that households with the land to devote to cash crops and who also are able to provide the labour that the production of these crops requires can expect to increase their cash incomes. However, as indicated in the production function by the substantial variation in output between periods and confirmed by the experience of growers, these crops are plagued by production and marketing problems. It is clear that most households found wage employment a better source of income than cash cropping, at least for most of the period of fieldwork. Some cash cropping was still maintained by many households, perhaps as a form of insurance against loss of the wage-earning opportunity.

Summary of evidence about incomes. Based on the above results and on other data presented in this paper, the following conclusions are derived

- Resource access was found to have had little effect on the level of income during the survey period (perhaps because of deficiencies in the available measures of resource access)
- Karimui Spice Company provided a large proportion of the local population (including women) with the opportunity to earn wages.
- The frequency of wage employment had no negative effect on the sale of cash crops.

Overall, households with higher participation in the wage economy were found to have slightly higher levels of total (cash and subsistence) income on average than those with lower levels of wage employment.

Table 2.2 Factors affecting the level of perennial cash crop sales: linear regression

Variable	*b* coefficient	*t* statistic	elasticity at means
Mature coffee[a]	0.19	1.9	0.19
Mature cardamom[a]	0.19	2.5	0.09
Cash crop activity[b]	0.02	4.3	0.37
Period dummy[c]	0.37	4.1	
Constant	–0.06	–0.9	
Adjusted R^2	0.26		
Number of observations	174		

[a] Coffee and cardamom are expressed in hectares per adult equivalent.
[b] Cash crop activity represents the frequency (%) with which household members (males older than 12 years and females older than 8 years) worked in cash crop gardens.
[c] Period is a zero-one dummy variable (period 1 = 1).

Household consumption

Factors affecting cash expenditure. A linear approximation of the Almost Ideal Demand System (AIDS) of Deaton and Muellbauer (1980) was used to analyse household demand for various groups of commodities. In the AIDS model, commodity group expenditure shares are regressed as a system of equations against the corresponding prices, an index of total income (or total expenditure) and other relevant variables. The AIDS model has important theoretical advantages for the estimation of demand systems and has been found to give robust estimates in a number of studies. Elasticity estimates relevant for policy analysis are readily obtainable from the estimated model. The equations were estimated using a maximum likelihood technique (Bewley 1989).

On the basis of preliminary work by Finlayson (1989), it was decided to limit the AIDS estimation to cash expenditures, excluding subsistence consumption. One reason is that, under the conditions at Karimui where subsistence remains important in the household economy, the (probably rather substantial) sampling errors in measuring subsistence will be highly correlated with errors in total expenditure term, leading to bias in the

estimates—in particular, to over-estimation of the income elasticity of food (Bouis and Haddad 1990b). Moreover, the proposition that source of income affects human nutrition implies that income from different sources, particularly cash and subsistence income, cannot be combined simply by valuing subsistence output at market prices and adding. An expenditure analysis based on such aggregation therefore begs the question central to the investigation.

Cash expenditures were categorised into two food expenditure groups—staples and proteins—and 'other expenditure' for each household in two survey periods. Commodity aggregation was necessary to minimise the number of zero observations, which complicate estimation. Price indices were calculated for each expenditure groups based on the local price information gathered. Prices varied by village and period. Selected demographic and other variables thought to influence expenditure patterns were also included in the model. However, tests of exclusion based on F-statistics indicated that most of these additional variables added little to the explanatory power of the model and they were therefore dropped, leaving only a variable for the proportion of income earned by women. Unfortunately, it was found that the price variables for staples and protein also failed the exclusion tests. However, these variables were retained on grounds of their *a priori* relevance. Asymptotic test statistics showed that the data did not violate the imposed restrictions of homogeneity and symmetry.

Results, presented in Table 2.3, are disappointing, with a rather low proportion of estimated coefficients showing high *t*-statistics. Most seriously, the *t*-statistics for most of the price variables were low, perhaps because of the limited amount of variability in the observed prices—a problem inherent to the analysis of cross section data of this kind. However, the coefficients of the total expenditure term were all highly significant and reasonably robust. Estimates of marginal budget shares and income elasticities were therefore calculated with some confidence. These results, along with the less reliable own-price elasticities, are shown in Table 2.4. They indicate that consumption of both purchased staples and purchased protein foods would rise with an increase in total cash expenditure, a 10 per cent increase in total expenditure yielding an estimated seven per cent increase in consumption in both cases. It is a little surprising that the two elasticities are almost the same since a higher elasticity would normally be expected for the protein foods. A possible

Table 2.3 Estimation of household cash expenditure patternsin Karimui, Papua New Guinea: regression results using the AIDS model

Dependent variable	Independent variable	*b* coefficient	*t* statistic
Staples	Staple price	0.051	0.78
	Protein price	0.116	0.92
	Price of other items	–0.167	–1.51
	Total expenditure (log)	–0.049	–5.85
	Female income (%)	0.066	2.1
	Constant	–0.081	–1.11
Protein	Staple price	0.116	0.92
	Protein price	–0.123	–0.30
	Price of other items	0.007	0.02
	Total expenditure (log)	–0.061	–5.48
	Female income (%)	–0.004	–0.09
	Constant	0.054	0.26
Other	Staple price	–0.167	–1.51
	Protein price	0.007	0.02
	Price of other items	0.160	0.60
	Total expenditure (log)	0.110	7.59
	Female income (%)	–0.062	–1.15
	Constant	1.028	6.55
	Adjusted *R*2: Equation 1	0.29	
	Adjusted *R*2: Equation 2	0.19	
	Adjusted *R*2: Equation 3	0.35	
	Number of observations	174	

Table 2.4 Own-price and expenditure elasticities for cash expenditure categories

Expenditure category	Budget share %	Own-price elasticity[a,b]	Expenditure elasticity[a]
Purchased staples	16.8	–0.64	0.70
Purchased protein	20.7	–1.56	0.71
Other items	62.5	–0.86	1.18

[a] Elasticities are calculated using the modified formulae for the linear approximation of AIDS given by Green and Alston (1990a, b).

[b] The *t*-statistics for the coefficients used in calculating these own-price elasticities were all low, so that these estimates should be viewed with considerable caution.

explanation is that, at Karimui, purchased staples may be more readily replaced by subsistence production than is possible for the purchased protein foods.

Cash expenditure on 'other items' appears to be more elastic than for the two food categories: a 10 per cent increase in total expenditure yields an estimated 12 per cent increase in consumption. While it is difficult to formulate clear expectations of behaviour of families given the broad nature of this expenditure group, goods included such as beer and purchased tobacco products are of a less essential nature than purchased foods. The higher expenditure elasticity for the other items therefore seems plausible.

The results in Table 2.2 relating to the proportion of income earned by females suggest that women direct a higher proportion of their disposable income to the purchase of staple foods than do men. Because their incomes are higher, men spend more than women on food but women devote a higher proportion of their discretionary income to food, both staples and protein foods.

Factors affecting subsistence consumption. In an attempt to estimate the effects of cash income on subsistence consumption, a log-linear demand function was estimated by OLS regression. The log-linear function was chosen for its relative flexibility and simplicity of interpretation. The logarithm of an index of volume of subsistence consumption was regressed on logarithms of own price and of the prices of purchased staples, purchased protein foods and other purchased goods and service. The logarithm of total cash income was also included as an explanatory variable.

The resultant equation was

$$\ln Q_c = 21.5 + 4.48\ln P_s - 10.6\ln P_p + 3.57\ln P_o - 1.21\ln P_c - 0.0432\ln C_y,$$
$$(1.80)\ (6.63)\ (-1.93)(0.97)\ (-1.45)\ (-0.97)$$

where

Q_c is an index of consumption of quantity of subsistence foods consumed per adult equivalent

P_s is the price index of purchased staple foods

P_p is the price index of purchased protein foods

P_o is the price index of other purchased items

P_c is the price index of subsistence foods

C_y is total cash expenditure per adult equivalent

figures in parentheses are *t*-statistics.

An adjusted R^2 of 0.41 indicates only moderate explanatory power of the equation. The model suggests positive elasticities of subsistence consumption with respect to prices of purchased staples and other purchased items, although only the first of these is significant. The signs of these coefficients accord with expectations. On the other hand, the elasticity with respect to the price of purchased proteins is negative, with a fairly high *t*-statistic, suggesting that these two food types are complements. It is difficult to form an unambiguous expectation about the sign for own-price elasticity; the estimated value is negative though not significant. The magnitudes of all the price elasticities are higher than might have been expected, raising a doubt about the reliability of the estimates.

The elasticity of subsistence consumption with respect to cash income is small and negative, although again not significantly so. Despite the unreliability of the estimate, this finding is in accord with the indications from the tabular analysis that Karimui households were apparently able to expand cash incomes with rather little loss of subsistence output, and hence consumption.

In summary, subsistence consumption was found to be sensitive to changes in prices of purchased goods, especially staple foods. If staple prices rise, households increase their reliance on home-grown products, as expected. It seems that Karimui households have been able to use cash to buy food to supplement subsistence supplies rather than to replace them—over the period of the investigation the elasticity of subsistence consumption with respect to cash income appears to be close to zero. It is obvious, however, that increased involvement of households in the cash economy would involve some replacement of subsistence foods with purchased foods in the longer run.

Household nutrient availability

In view of the less than wholly satisfactory explanations obtained of the determinants of household consumption behaviour, no attempt was made to extend the models to derive estimates of elasticities of nutrient consumption by applying food-to-nutrient conversion factors. A number of authors (Murty and Radhakrishna 1981; Strauss 1982; Pitt 1983) have argued that such indirect estimates of nutrient elasticities are to be preferred to direct estimates, on the grounds that prior restrictions derived from economic theory are more readily imposed on the demand system

estimated in terms of goods and services. However, the method does depend on a high degree of disaggregation of food commodity groups since income-induced changes in consumption within groups are overlooked. Because the analysis has been attempted only for broad food groups, the indirect method seems not applicable and a direct approach to estimation of household nutrient availability is preferred.

Household energy from different sources was related to resource access and other factors. The dependent variables were household energy from gardens, and tree and bush sources, and energy purchased, estimated as a system. In addition to the factors thought to affect the supply of food from each source, the food energy levels from each of the other sources were included in each equation. Because little is known about the factors affecting food received as gifts, no equation for energy from this source was included, but energy from gifts was initially included among the explanatory variables for the other equations (though it was found not to improve the explanatory power of the model). Prices were not included among the explanatory variables. The model was estimated using three-stage least squares regression, as there was contemporaneous correlation between the disturbances.

Results are given in Table 2.4. The explanatory ability of the model appears to be constrained by difficulty in collecting information on energy from subsistence sources and labour use, and by problems in measuring access to food tree resources. However, the following conclusions may be deduced from the model.

Gardens and trees were complementary sources of energy for Karimui households over the study period.

Energy from gardens was negatively affected by level of energy purchased, but was not significantly affected by the level of wage employment.

Purchased energy sources were not significantly affected by levels of garden or tree energy but were positively related to the level of cash income, of which Karimui Spice Company and other wages were the main components.

Nutritional status of young children

Two kinds of anthropomorphic measures of nutrient status of children under five were used. Most analyses were based on rates of growth in length or weight of children observed in the two six-month survey periods. Percentages of standard weight-for-age, length-for-age and weight-for-length of children were also used.

The determinants of nutritional status were classified as

- biological factors, such as age and pre-existing nutritional status
- behavioural factors, such as weaning status and maternal care
- environmental factors, such as frequency of morbidity, household size and diet.

Simple regression models were used to relate the observed nutritional status of the sample children in the two survey periods to these types of factors. The models were structured to control for factors such as age, that were known to be important determinants of nutritional status, to assess better the impacts of factors thought to be associated with the commercialisation of agriculture at Karimui, such as child care and diet.

The models were constructed in a variety of ways to clarify the impact of commercialisation, as indicated in Figure 2.3. In turn, measures of household energy availability, type and sources of foods consumed by the family, household expenditure by type, level and sources of household income, and household resource access were tried.

The explanatory power of all these models was generally modest, and it proved difficult to establish any firm links between commercialisation and nutritional status. However, overall, it is clear that the effects of household income, expenditure and hence food consumption on growth are complex and not well captured in the models. Any impacts of commercialisation are apparently largely swamped by the more dominant impacts of biological factors and other factors unlikely to be closely associated in the short run with level and source of income. It is also apparent that the two six-month periods of recording were different, and that the impacts on children in the weaning phase were different from those for pre-and post-weaning children.

Despite the limited explanatory power of the regression models, it is possible, drawing on the results obtained, to suggest an interpretation of the way wage income, and hence purchased energy affected the growth of children at Karimui. In the first interval, households that were initially on higher incomes experienced a large drop in the availability of cash over the period, which in turn affected their ability to feed their children. It is suggested that children from households more reliant on purchased foods experienced some growth faltering as mothers struggled to replace purchased foods with foods from subsistence sources. The more successful households in this endeavour may have been those with better access to 'tree food' sources. In the second period, a more normal situation prevailed and children from households with higher cash incomes, at least for children in the weaning phase, benefited from a greater proportion of energy coming from purchased sources, made possible by access to cash. These are the children most vulnerable to nutritional stress.

While more work is required to investigate these hypothesised effects more fully, there does appear to be a consistent relationship persisting across the weight and length growth models with respect to the following factors

- Age of the child was the dominant factor determining growth velocity.
- Nutritional status at the start of the growth period was significant in its effect on growth velocity.
- Children who were in the weaning phase were particularly prone to the impact of factors causing growth faltering.
- Morbidity, especially diarrhoea, has a detrimental effect on growth.

The source and type of food available appears to affect growth rate according to the economic conditions in the community.

Concluding comments

From this study, there is no conclusive evidence of any detrimental effect of commercialisation of agriculture on the growth of children at Karimui. On the contrary, there is some evidence that the greater diversity of foods consumed made possible through higher cash income from wage employment or other sources can have benefits for the nutrition and growth of children. However, the analysis also points to the risk of a lowering of food security if households cut back on subsistence production too strongly and then find their cash income sources drying up, as happened

at Karimui Spice Company. Results emphasise the strength and flexibility of the mixed cash and subsistence system as a basis for household food security at Karimui.

The importance of child—weaning practices and of health and hygiene is also highlighted, indicating a need for better community education in these areas and for the maintenance of health facilities, such as aid-posts and immunisation programs.

Smallholder coffee farming systems in Papua New Guinea:household objectives and constraints to development

Duncan Overfield

Agriculture is the main activity and source of income for more than 80 per cent of the population in Papua New Guinea. Coffee, cocoa, copra and oil palm account for 90 per cent of agricultural exports with limited amounts of tea and rubber making up the residual (Bank of Papua New Guinea 1993:S33).

The coffee industry is dominated by small semi-subsistence growers who account for 70 per cent of national production (Smith and Kuimbakul 1993:10). Coffee forms a major component of the cropping and livelihood strategies pursued by these growers; in most Highland districts it is grown by over 95 per cent of households (NSO 1991:2) and is the main source of cash income for the vast majority of households (Overfield 1991:11; 1993a:11). Subsistence food production is integrated with coffee cultivation; there is an increasing incidence of intercropping in the Highlands (Ghodake et al. 1993:15-20).

According to figures produced by the PNG Coffee Industry Corporation (CIC), coffee accounts for 34 per cent of all smallholder household incomes (Overfield 1993a:11). This figure is based on a sample of only 18 households and it understates the importance of coffee as an income source to village communities; many other sources of income, such as the selling of food crops and animals most of which is done within communities and not externally to urban consumers, are dependent on coffee revenue to provide effective demand within the village. Without the

external income from coffee there is insufficient money within the rural economy to purchase much of its agricultural output. Coffee is virtually the only external source of income for rural dwellers in the Highlands.

Household food requirements are met mainly from subsistence production, with sweet potato being the main staple. Considerable amounts of food are also marketed for cash, mainly within villages but also to nearby urban communities. However, coffee remains by far the most important source of cash income. Smallholders combine food (mainly subsistence) and coffee production to produce enough to eat, generate cash income and to reduce their exposure to production and market risk. This strategy allows them access to cash income without fully exposing themselves (and their entitlements to an adequate food supply) to the volatility of international commodity markets. They have relative autonomy from market relations and can be regarded as a peasantry (defined as producers wholly or partially removed from market relations) in transition. Observers have referred to the current smallholder mode of production as one of 'subsistence malaise' (Grossman 1984), 'arrested transition' (Collett 1992) or even a stage of 'terminal development' (Howlett 1973). All terms attest to the notion that, because of various economic, social and cultural constraints, producers are stuck between a pure peasant mode of production and capitalism.

This notion is assessed whilst describing how households achieve their three main economic objectives: producing enough to eat, generating cash income and effectively managing risk. Separate consideration is given to development constraints—both internal and external to the household—before concluding with the policy implications of the analysis.

Household objective I: producing enough to eat

Smallholders in the Highlands are efficient food producers; it has been generally asserted that they have a significant surplus of both land and labour, a state often referred to as 'subsistence affluence'. Fisk (1971:368) defined this as

> ...a condition in which population pressure on land resources is relatively light, productivity per unit of applied labour (as distinct from available labour) is very high, and most subsistence agriculturalists are able to produce as

> much as they can consume, with satisfaction of their main essential requirements, and to sustain an adequate level of living by their traditional standards, at the cost of as little as fifteen or twenty hours per week.

Given that this statement relates to work conducted nearly 25 years ago, with a period of rapid change since, does it still hold? What levels of resources are currently allocated to food production and do significant surpluses still exist? Information on labour allocation from the CIC smallholder monitoring study shows that 10.5 hours per day are spent by a household on food production, 4.0 hours on coffee production, and 4.6 hours on household chores. These figures are based on 25 monitoring points (days) in 1992, and do not include off-farm work or paid employment. Average land area allocated to food production per household is 0.46 ha compared with 0.38 ha for coffee production. Caution should be used when interpreting these figures as they are based on the detailed monitoring of only 18 households (see Overfield and Irog 1992). Nonetheless, it would appear that activities associated with basic food production and household reproduction take priority over cash crop cultivation.

The average household size in this study is 6.4, implying an overall labour utilisation of 56 per cent based on the number of workers in a household (and assuming available time per day of 12 hours). This estimate suggests that there is no labour constraint (for the whole household, not considering particular categories of labour) but also implies higher overall levels of labour utilisation than indicated by results from previous work (Overfield 1993a:10). As might be expected, however, there is considerable variation between households: women and men do not work equal hours nor is their labour perfectly substitutable. More detailed consideration is given below to the existence, or otherwise, of a household labour constraint.

It is difficult to measure subsistence food production accurately, but assessing what factors determine areas planted provides useful information about resource utilisation decisions. Food areas have been found to be closely associated with household size, producing a near linear elasticity that suggests this is very much a subsistence activity (Overfield and Irog 1992:8-46). Also, areas were found by Overfield and Irog to be positively related to degree of access to an urban centre (possibly suggesting that more food crops are sold for cash where there is greater access to urban markets) and the number of female workers (the impact of male labour availability could not be established). The importance of women's contributions is supported by the labour input data

showing that women provide the majority of the labour for food production. Household size had the strongest influence, followed by market access and then the number of female workers (Overfield and Irog:8,46).

It would appear that food production is predominantly a subsistence activity. This is a rational choice for smallholders to make given the terms of trade between cash crops and trade store goods (the other main source of food). It costs less to generate a sufficient entitlement to an adequate food supply by subsistence (non-traded) production than by cultivating cash crops and in turn trading them for bought food items. Producing enough food to eat is both rational and efficient.

Household objective II: cash income generation

Recent CIC studies (Overfield 1991,1993a) reveal that coffee smallholders are involved in a large number of income-generating activities. These activities are undertaken to meet cash requirements for basic items such as school fees and health care charges, and to obtain cash to spend on other consumption items such as food and beverages. It seems that the primary reason why smallholders engage in cash-earning activities is to meet a minimum cash income need. What is the scope of these activities and which factors determine the level of household involvement?

Table 3.1, which contains results of detailed monitoring of 18 households over a 12-month period, shows that smallholders derive cash from a number of sources of which coffee is by far the single most important. Bearing in mind that the figures in this table are gross and that most activities are internal to the village community (that is, most market transactions take place within the close geographical area of production), coffee assumes greater importance. Besides coffee, paid employment and sales of artefacts are the only other activities which provide external sources of cash for the village (and are therefore not dependent on village effective demand). Together, they produce a total annual income of K124—less than one-third of that provided by coffee. Clearly, there is a high dependence on coffee in the Highlands village economy, with perhaps more than two-thirds of effective purchasing power coming from sales of this crop. Coffee is the driving force behind many other parts of the rural economy.

Table 3.1 Ranking of household income sources in Papua New Guinea

Source	Rank	Income[a]	%
Coffee	1	386	33
Food[b]	2	225	19
Animal sales	3	165	14
Small business income[c]	4	116	10
Price[d]	5	102	8
Paid employment	6	88	7
Cultural/Gifts	7	42	3
Bilums/Artefacts	8	36	3
Compensation	9	27	2
Total		1187	100

[a] Kina income in 1992. At the time of data collection, the exchange rate for the Kina was K1=US$1.0129.
[b] Marketed food only.
[c] Includes many informal business activities such as scone selling.
[d] This is a 'one-off', or irregular, source of income for any individual household.

Source: Overfield D., 1993a. *Coffee and Smallholder Households in Benabena District, Eastern Highlands Province: Economic issues and interim results*, Coffee Discussion Paper No. 10, Coffee Industry Corporation, Goroka.

There can be little doubt that smallholders are dynamic in their outlook: coffee cultivation spread most rapidly throughout the Highlands in the 1960s and early 1970s when extension services had been suspended due to the ratification of the International Coffee Agreement (ICA) by Australia. A number of observers (Grossman 1984; Thompson and MacWilliam 1992) have commented on the rational behaviour of small coffee growers in moving in and out of coffee production according to price levels, attaining a level of autonomy from market relations. Commenting on the results of a national survey of smallholder coffee growers, Overfield (1991:11) concluded that

> ... as coffee prices have fallen ... there does appear to have been some movement back into subsistence production; 13 per cent of smallholders indicated that they were now growing more of their own food as a direct result of coffee price falls.

There is strong evidence that growers respond rationally to market signals in balancing coffee and subsistence food production. Two studies have shown coffee growers in Papua New Guinea to be price responsive, placing price elasticities of supply between 0.18 and 0.27 (Jolly et al. 1989; Overfield 1991). How does this relate to the relative returns between the two main agricultural activities in the Highlands: food production and coffee growing? Do households respond in a meaningful way to different returns?

Overfield (1993a) has shown that coffee gave lower average returns to land (K1092/ha) than food production (K2887/ha) in 1992 when subsistence production was valued at local market prices. However, returns to labour in coffee production (K3.04/day) were higher than those in food production (K2.08/day), even when allowance is made for the value of subsistence food output. Moreover, coffee price support increased considerably at the end of 1992 which would have increased returns to labour to approximately K4.50 per day during 1993.

Table 3.1 shows that the single most important source of cash was coffee, which fits with producers wanting to maximise returns to their labour. However, a considerable amount of food (around 25 per cent of total production) is still being sold for cash: why is this the case considering the labour returns to coffee are so much greater? This question is largely answered by examining labour returns by gender. Returns to female labour in the coffee industry were estimated at K1.68/day, compared with K5.04 to male labour, placing returns to food production above female labour returns from coffee. Women have greater access to the cash returns from food production (being virtually totally responsible for food sales) than they do for coffee, and may therefore be prepared to apply more time to this activity even though it produces a much lower overall return for the household (assuming these average returns also reflect marginal returns fairly closely). It comes down very much to the feminist critique of neoclassical household economics: households are not homogeneous units working towards a common goal but rather a power hierarchy with men at the top restricting the access of women to the returns from their labour. It is no surprise that women react to their situation with some economic rationality.

There are other determinants of the range and nature of cash–earning activities, and other determinants of coffee production in particular (Overfield 1991:8–11). In most surveys, price is found to be by far the

most important factor. The analysis by Overfield (1993a) suggests that returns should not be aggregated at the household level because individuals are price responsive and receive different returns to their labour.

The intercropping of coffee and food is an agronomic practice which is increasing in the Highlands. According to a survey by the Papua New Guinea Department of Agriculture and Livestock (DAL), the proportion of surveyed gardens being intercropped increased from 31 per cent in 1988 to 66 per cent in 1991, with the trend consistent across most Highlands coffee-producing areas (Ghodake et al. 1993:11-19). In the past, intercropping has been discouraged by extension agents because it was believed to reduce overall returns to land and labour. Trials currently being conducted by DAL in the Highlands suggest that this may not be the case. On the contrary, DAL found that coffee intercropped with sweet potato at a 75/25 per cent density ratio produces 82 per cent more net income per hectare than mono-cropped coffee (Kanua 1993:7-9,14). Smallholders have innovated with a practice they have found effective through their own informal experimentation; formal research is only just beginning to 'discover' this. It is another indication that smallholders are rational and prepared to innovate with practices which they feel make sense.

Household objective III: risk management

Risk management can usefully be split into two: (a) production risk associated with physical growing conditions (floods, droughts etc.); and (b) price risk linked to exposure to volatile and unpredictable markets (uncertain prices). How do coffee smallholders in the Highlands of Papua New Guinea deal with these two elements of risk?

Information presented above shows that smallholders are involved in a wide range of cash-generating activities which protect them from both production and price risks. They also grow most of their own food which further insulates them from variability in their food entitlements associated with dependence on a single internationally traded commodity such as coffee. The quite high dependence of smallholders on subsistence cropping coupled with crop diversity can be interpreted as primarily a strategy to manage price risk rather than production risk. Such behaviour appears rational given the relatively low-risk physical environment and the highly volatile international coffee market. Many smallholders also

manage subsistence risk by producing more food than is needed on average, and selling any surplus in the fresh produce markets or using it to create or discharge social obligations.

There is another element of smallholder economic behaviour which suggests they are highly price risk-averse: the low or negligible use of variable cash inputs such as fertiliser. Even though the value of marginal product of these inputs is greater than their marginal cost for most smallholders, they seldom use them because of the risk of output prices falling between the input application and sale of the final product, something that has often occurred in coffee production. Risk aversion may be one reason for this observed behaviour but it could also be related to household budget constraints and/or a strong preference for consumption over investment. A plausible conclusion is that smallholders are effectively managing risk, and placing particular emphasis on that associated with volatile international commodity markets.

Household objectives: competing or complementary

Many writers have argued that cash cropping can only damage subsistence production systems. Grossman (1984:219), for example, cites the replacement of subsistence 'affluence' with subsistence 'malaise', where a

> ... previously strong commitment to subsistence production has declined because of a negative comparison to commodity production and other externally derived activities resulting in lower local food production and a deterioration in the resilience of the subsistence systems.

A high commitment to cash cropping has been found in many areas of Papua New Guinea; plantings of cocoa were so extensive amongst the Nagovisi of North Solomons Province that, in some areas, land for subsistence gardening was very scarce (Mitchell 1976). Similar patterns have been observed in parts of East Africa (Datoo 1977), Nicaragua (Nietschmann 1973, 1979) and Brazil (Gross and Underwood 1971). This pattern of preference contrasts with evidence from some other peasant

societies where generally it was found producers first satisfied household food requirements and only then engaged in commercial activity (Wolf 1969; Tosh 1978; Lofchie 1980; Guillet 1981).

The evidence presented in this paper suggests that cash and subsistence production are largely competing activities: is this important? Where households have access to plentiful labour and land, which appears to be the case in most Highlands areas, they can shift between the different activities depending on which gives the best economic return. Where access to these resources (in particular, land), declines, it seems that subsistence production is given much greater emphasis (Overfield and Irog 1992:6-9). The way smallholders manage risk implies that, in devising livelihood strategies, generation of sufficient entitlements to an adequate food supply (mostly through subsistence production) is given priority. Household resource endowments are important in determining the extent of commercial involvement. These endowments appear to constitute the main constraint to further commercial smallholder development.

Household constraints I: internal

Are current circumstances within the smallholder sector constraining its development? Are smallholders in an arrested transition to capitalism? What role does customary land tenure play? Is there a significant labour shortage? Access to land under customary land tenure is flexible and allows households adequate access to land: it is the shortage of labour which forms the binding household constraint. Collett (1992:157) recently commented

> 'Customary' land tenure has proved sufficiently adaptable to enable inequalities in coffee holdings to develop, and a small number of 'big peasants' to emerge. Yet the same 'customary' tenure asserts the rights of households to land and, by so doing, precludes the formation of a landless proletariat. At the current juncture, the small labour supply at peak harvest season, coupled with the exigencies of household reproduction, prevent the inequalities in coffee holdings being fully converted into differentials in income, wealth and capital accumulation, without which social differentiation cannot proceed.

Collett implies that land tenure creates a secondary constraint to the transition to capitalist farming by preventing both the formation of a class of landless labourers to the work on the holdings of emergent capitalists and any significant capital accumulation. A more positive interpretation is that it provides households with considerable autonomy from market relations reducing the level of risk they face.

Do smallholder households really suffer from a labour constraint? Overfield (1993a:10) found that, on average, there was considerable household underemployment (56 per cent utilisation rate) with three households out of eighteen experiencing an overall labour constraint. Labour shortage became worse during the coffee flush (main harvest) period with another two households experiencing a labour constraint and the situation becoming more extreme in the first three households. This evidence lends some support to the arguments advanced by Collett, but households experiencing a constraint were not necessarily those with the largest holdings of coffee. An understanding of factors at work within the household provides greater insight, particularly the unequal division of work between women and men.

Women are working considerably longer hours than men. According to Overfield (1993a:10), women work on average 14.8 hours per day (72 per cent of total available time) compared with 7.1 hours for men (42 per cent). It was traditionally believed that women do most of the household chores and subsistence cropping and men more of the cash cropping. Overfield's (1993a) study revealed that women were doing one-half of the labour associated with coffee production and about three-quarters of all other work. Their burden is considerable, and it is the female labour constraint that is far more binding in most households: in no household was there a male labour constraint, either in or out of the coffee flush (Overfield 1993a:11).

This unequal distribution of tasks within the household is a product of the social subordination of women in Highlands society. Customary land tenure is predominantly patrilineal, and a woman's access to land is accomplished by activating use rights to her husband's land. Women are considered to have secondary use rights (Strathern 1969,1982; Sexton 1986; Nihill 1991) and limited decision-making power (Overfield 1991:12) with their labour contributions giving limited access to any coffee income. As shown above, the return women receive on their labour in coffee production is only about one-third of the returns in coffee production received by their male counterparts. The disparity reduces household

coffee incomes (Overfield 1993a:15-6) as women place more emphasis on less profitable activities but ones in which they have greater access to the returns.

The uptake and maintenance of large amounts of cash cropping suggest that smallholders aspire to become involved in the cash economy. They are constrained by factors which are internal to Highlands society of which the principal one is discrimination against women. Social subordination on the basis of gender produces unequal division of tasks, constraining available time, and inequitable returns to labour in coffee production, which depresses household incomes. This is a considerable long-term constraint.

Household constraints II: external

There are other constraints of an external nature which have an impact on smallholder development. They fall into three categories: infrastructure or market access; major social upheavals that are taking place in Papua New Guinea; and the macroeconomic situation.

Poor infrastructure and associated lack of access to markets have been found to reduce household coffee incomes in CIC studies (Overfield and Irog 1992:10-12, 45, 47; Overfield 1993a:15-16, 32). They are often mentioned by smallholders as a limiting factor. Marketing constraints and relative prices are also related to infrastructural constraints: policies to increase grower returns (such as marketing groups) can be expected to have a positive impact on household production by removing some of these constraints which exacerbate remoteness from markets. However, logistical problems were mentioned with greatest frequency by smallholders and extension agents in a CIC survey of marketing groups (Overfield 1993b:9).

The constraints associated with social upheaval manifest themselves principally in the form of Papua New Guinea's well publicised law and order problem. Social changes in PNG have produced the 'rascal' problem which is a significant constraint on smallholder development. The main way this acts as a constraint is by disrupting produce marketing through theft of the product and/or revenue with armed hold-ups on public highways being a relatively common occurrence. This of course has a huge disincentive effect on growers, particularly for innovations like marketing groups which work on a principle of bulk handling and transport and are

therefore more vulnerable as they are associated with large amounts of produce and cash. It makes it very difficult to implement new agricultural development policies concerned with marketing initiatives.

The last constraining factor is the economic dependence on coffee by households, in particular, and the Highlands economy, in general. This confines development paths to the trends and movements in the international coffee market and the political support that exists at any particular time (mainly in terms of price support). Fundamentals in the coffee market, as for most primary commodities, are not promising and, although political support is high within Papua New Guinea with the producer price of coffee still supported by the government, it is wavering in the face of a World Bank-dictated structural adjustment program which makes this type of support highly uncertain in nature. The long-term market fundamentals should be regarded as a more reliable guide to future resource allocation, yet they remain uncertain.

Rural institutions also tend to be constructed around this economic dependence on coffee, which creates vested interests and constrains any impetus to move into other areas of agricultural endeavour. It is very difficult to break this vicious economic, and associated institutional, cycle.

Conclusion: policy implications for the 21st century

There is considerable debate over the potential for smallholder agricultural development in the South Pacific, with many observers referring to a state of 'arrested' transition in smallholder agriculture in Papua New Guinea. This chapter attempts to shed some light on this debate by exploring how smallholder coffee growers in the Highlands of Papua New Guinea achieve their main household objectives and what impact the constraints they face have upon the economic activities into which they enter. Evidence mainly from a smallholder monitoring study supports the notions that

- given the circumstances they face, smallholders are rational in what they produce and the range of economic activities they enter into; and
- constraints internal to the household form a greater barrier to smallholder agricultural development than any external factors.

Smallholders allocate the resources at their disposal to produce enough to eat, generate sufficient cash income, and manage production and price risk effectively. There is particular emphasis on management of price risk: the international coffee market produces greater risk than the physical environment of the Highlands. Smallholder householders are nevertheless constrained by a number of factors, both internal and external to the household.

Internal and external constraints produce different outcomes, are of different levels of importance, and require different forms of government intervention. The main internal constraint identified was the social subordination of women, which reduces their labour returns, produces unequal work burdens (and therefore an effective labour constraint) and reduces household coffee incomes. Perhaps the main external constraint is that of infrastructure and market access. Analysis suggests that the internal constraint has far more influence on the economic well-being of the household.

The various strategies and policies implemented to overcome these constraints have different time scales. Strategies to address gender discrimination are long-term. They include education and female empowerment which are bound to be slow in taking effect as they are concerned with changing attitudes in society. There are, of course, short-term policies such as women-only marketing co-operatives, but the main thrust has to be on attitudes. Market access, on the other hand, has to do with investment policy and this could reasonably be expected to have a positive impact in the short to medium term. Of the other external issues mentioned, law and order is a long-term problem the solution to which relies on strategies and policies which create economic opportunities and social stability (along with effective law enforcement). Economic dependence on coffee is a matter of economic policy direction and planning, with established institutions having a key role to play.

Dependence on coffee is a recent historic fact but it must be reduced or smallholder economic development will always be constrained by the vagaries of this volatile international commodity market. Institutions need to focus on the farming and household economic system, and not on one commodity. It means providing research and extension services which

grapple with issues such as intercropping and appropriate means of expanding household incomes. These institutions also need to be sensitive to gender issues.

While the focus of this chapter has been on the farming and household economic system associated with coffee production in the Highlands of Papua New Guinea, it is also relevant to other areas of Melanesia where subsistence and cash cropping are integrated, where land is held under patrilineal customary tenure, and where there is social subordination of women.

Food import substitution in Papua New Guinea: a case study of sugar production

Rufina Peter

A number of industries in Papua New Guinea benefit from some form of trade protection. Poultry, sugar and certain pork products benefit from a total ban on imports. Except for onions, most vegetables are covered by one or more forms of protection that include total bans, tariffs and quotas. Most of these industries have used the 'infant industry argument' to obtain and keep protection. There is no shortage of proponents for extending protection into other industries such as beef, citrus and rice. The argument is whether or not the infant industries will ever 'grow up'. That is to say, does the country have comparative advantage in the production of these commodities?

Encouraging import-substituting industries can appear very attractive to economic planners in developing countries, but the advantages may be illusory unless a thorough analysis of the economic impact of such industries is undertaken to ensure scarce resources are efficiently allocated in supporting these industries.

Until recently, governments of most developing countries believed in the power of industrialisation to generate economic growth, and pursued an 'import-substitution' strategy of urban-based industrial development. The foundation of this belief lay in declining prices in world markets for their primary products and consequent growing balance of payments deficits. The typical strategy for import substitution is first to erect tariff barriers or quotas on the importation of certain commodities, then set up a local industry to produce these goods. It usually entails cooperation with foreign companies which are encouraged to establish their own operations or joint ventures through tax and investment incentives. While initial costs of production may be higher than former import prices, the

economic rationale put forward for the establishment of import-substituting industries is twofold. First, the industry will eventually be able to reap the benefits of large-scale production and lower costs (the so called 'infant industry' argument for tariff protection). Second, the balance of payments will be improved as fewer consumer goods are imported. Often, a combination of these arguments is advanced. Eventually, it is hoped that the infant industry will expand, lower its average costs of production and compete in world markets. It will then be able to generate net foreign-exchange earnings.

In the case of the sugar industry in Papua New Guinea, there was indigenous political pressure for the establishment of a national sugar industry. The aim was primarily to ensure self-sufficiency in sugar, thereby eliminating a costly import item, in compliance with national development goals. Since its establishment, the sugar industry has been managed by a private company, Ramu Sugar Limited (RSL). To date, no study has been conducted to evaluate the impact of the industry on the national economy nor determine whether the country has comparative advantage in producing sugar.

Commercial sugar production in Papua New Guinea is a protected industry which consists of a monopoly producer, RSL, which is fully shielded from foreign competition by a ten-year ban on imports of sugar and sugar substitutes. The domestic price of sugar is fixed in accordance with an agreement between the industry and the government. The present pricing formula allows the sugar price to be adjusted at six-monthly intervals in line with changes in the consumer price index (CPI). Now, when the infant-industry protection should be lifted, the company has not shown it can compete with imports. The company made losses in five out of its first 11 years of operation, did marginally better than break even in three years and made notable profits in only three years (Gucan 1992).

Shareholders of the company received no share dividends during the first decade of operation of RSL. The offshore loan repayments are about the only debt repayments that have been made by the company. Forecasts made in the feasibility study were too optimistic in terms of sugar prices, yields and currency exchange rates (RSL 1992). The economic viability of the company is therefore in question without infant-industry protection. Before renegotiation of current agreements, it is important to know whether Papua New Guinea does have a comparative advantage in producing sugar. To investigate the comparative advantage in producing sugar, calculations are made of the domestic resource cost (DRC) ratios and

the financial and economic profitability of producing sugar under the current industry structure, and under both current economic circumstances and with trade liberalisation.

Overview of the Papua New Guinea sugar industry

Importance of sugar to the economy

Key policy objectives in Papua New Guinea have been the development of a wider range of export crops, a reduction in the dependence on imported foodstuffs and a more equitable balance between urban and rural incomes. With these objectives in mind the government sought to develop a national sugar industry to meet national sugar consumption needs into the 1990s and beyond. Accordingly, Booker Agriculture International was commissioned in 1977 to report on the economic and technical feasibility of a sugar industry, based in the Markham or Upper Ramu river valleys, producing 30,000 tonne of sugar by 1985, rising by about five per cent per annum thereafter. It was concluded that a project with a nominal capacity of 42,000 tonne per annum would be commercially viable, provided the sugar price was linked to an import parity world sugar price of US$12.5c per lb. A development equity ratio of 60:40 and long-term loans at 10 per cent interest rate over 12 years were also key assumptions. The financial rate of return was calculated on this basis to be 13 per cent.

Major benefits to the economy from the development of this new industry seem to be

- import substitution of sugar and petroleum (through ethanol production), saving foreign exchange
- a focus for agricultural and other commercial development in a hitherto undeveloped and underpopulated area
- the establishment of infrastructure such as roads, housing, services, schools and clinics
- employment of some 1,500 nationals, supporting a new community of over 6,000 people
- a high level of training for nationals in agriculture, engineering and financial management
- revenue to government by way of direct and indirect taxation (Gucan 1992).

History of sugar in Papua New Guinea

Sugar cane is indigenous to Papua New Guinea, and villagers have long been growing several varieties. One particular variety called Badila (collected in 1896) became the backbone of commercial plantings elsewhere in the world (Densley 1977). Although commercial planting was contemplated as early as the 1950s, cane was not grown commercially in Papua New Guinea until 1978 when RSL was incorporated as a company by the government of Papua New Guinea. Structural problems prevented the early establishment of a commercial sugar industry, encompassing limited domestic market, high capital investment necessary for the production of sugar, the failure of international sugar agreements, geographical and climatic constraints, and a large non-monetised sector in agriculture.

Criticism by a visiting UN mission in 1962 of the failure by Papua New Guinea to grow sugar commercially, prompted the Australian Bureau of Agricultural Economics (now the Australian Bureau of Agricultural and Resource Economics or ABARE) to assess the viability of a commercial sugar industry. As a result of their feasibility study, ABARE suggested use of hand-operated crushing mills for production of crude sugar on a small scale in villages. Their recommendation for small-scale production was based on a low domestic demand which was between 2,000 and 3,000 tonne in 1951. By 1961, however, experimental work to this effect lapsed.

Despite the seemingly non-viable nature of commercial sugar production, indigenous political pressure for the establishment of an industry gained momentum. The impetus of this political pressure stemmed from increasing domestic demand for sugar over the years. With the increasing consumption of sugar, the import bill of sugar was also increasing. Furthermore, the setting up of a domestic sugar industry was in direct compliance with one of the eight aims of government, that of self-reliance. An increase in the price of sugar on the world market in 1963, which resulted from a drop in Cuban sugar production, was another reason favouring the establishment of a domestic sugar industry.

Private enterprise, together with the then Department of Agriculture, Stock and Fisheries (DASF), were at the forefront of feasibility studies and experimentation on sugar production carried out at specific locations throughout the country. Beginning in 1965, DASF conducted agronomic research, assisted by the BAE and the Australian sugar experiment

stations. Commercial trials were carried out in the Markham valley (Morobe Province), Brown River and Kemp Welch River (both near Port Moresby in Central Province), and Ramu Valley (Madang Province). The Ramu Valley location was chosen on the basis of available land area, low incidence of pests and diseases, absence of waterlogging, soils rich in nutrients, suitable topography and favourable climate. Thus, RSL was incorporated to develop a commercial sugar industry at Gusap in the Ramu Valley.

Starting from a green-field site in 1979, RSL developed and prepared the land, and planted sugar cane such that close to 6,500 ha of land was in productive use by 1983. The processing plant was commissioned in 1982 and production rose to 34,100 tonne by 1984. In 1985, agricultural problems caused a slight drop in output to 31,100 tonne; they worsened in 1986 when production slumped to 9400 tonne. Attempts to overcome these early production problems have been reasonably successful in the intervening decade.

Structure of the sugar industry

RSL holds a 99-year lease of some 26,000 ha of government land (bought from traditional landowners in 1956), of which approximately 7,500 ha are assigned for sugar operations and the remainder devoted to cattle ranching with a 15,000 to 16,000 herd supplying about 20 per cent of the domestic beef market. Sugar production operations have been machine-intensive in view of the limited labour supply in the local area. The capacity of the factory is 2,800 tonne of cane throughput per day and output of some 42,000 tonne of mill white sugar per year (assuming 190 days of operation between May and October).

As in most sugar-cane factories, the cane residue after crushing, known as bagasse, is used to generate steam and electricity. In addition to the needs of the factory, power is supplied to the adjacent houses and township buildings. Molasses, the residue after most of the sugar has been extracted from the syrup, is fermented to produce ethanol. This is dehydrated and used by the major oil companies operating within Papua New Guinea to blend with petrol. The sugar and associated ethanol components currently contribute 97 per cent of by-product revenue while beef contributes three per cent. Only the sugar by-product revenue has been included in the value of output in this study.

RSL is managed by Booker Agriculture International Limited which has a six per cent share holding in the venture. Commonwealth Development Corporation (CDC) owns 25 per cent and 12.2 per cent is owned by other minority off-shore shareholders. National share holding amounts to 56.8 per cent, of which 48.8 per cent is owned by the independent state of PNG, five per cent by the Public Officers Superannuation Board and three per cent by other minority national shareholders. The venture had an initial capital investment of K100 million. Shares for the company were sold in 1979 with K35 million subscribed by shareholders, while the remaining K65 million was sought from off-shore lenders to cover the cost of capitalisation of factory and estate development. Although the government is the single largest shareholder, it does not hold the majority of the ordinary shares and, hence, RSL is essentially a private sector company.

Sugar marketing and distribution

Prices and the pricing formula. Sales of sugar are made on an ex-factory basis to wholesalers, distributors and major retailers. Sugar destined for the retail trade is packed in 1 kg and 550 g packets, sugar for industrial users is in 50 kg bags, and sachets are produced for specialist consumers such as the national airline.

The maximum domestic price at 1 July 1984 was set by the Price Controller at K762 per tonne. Since then bi-annual adjustments related to the CPI have been permitted, with the proviso that the maximum increase in any 12 month period does not exceed 8 per cent (Kalit 1988). This formula was to remain in force for three years from 1 January 1985, but was subsequently extended to the end of the period covered by the rescheduled loan agreements (the present pricing formula came to an end on 1 January 1997).

Domestic marketing arrangements. RSL has a monopoly in the domestic market which extends to both household and industrial consumers of sugar. The domestic market capacity of sugar is 30,000 tonne, well below factory capacity of 42,000 tonne. Initial projections by the Department of Trade and Industry were too optimistic with the domestic market capacity estimated at 40,000 to 50,000 tonne per annum compared with current annual domestic consumption of approximately 28,000 tonne. Consequently, Ramu has exported sugar to USA, New Zealand and Sri Lanka, and, at the time of writing, new export markets are being sought in Europe and elsewhere.

World market. Sugar is marketed internationally under complex institutional and contractual arrangements reflecting the interests and requirements of individual exporting and importing countries. There are three market segments

- controlled markets, which include the various international attempts by exporters and importers to regulate market operations—international sugar agreements (ISAs) obviously fall into this category
- preferential and guaranteed markets, which include the various forms of bilateral deals and special arrangements between exporting and importing countries
- the free market which, as its name implies, offers no preferences or guarantees and is a residual market.

World sugar prices. There is no single price for sugar because there are several types of sugar and the price for each depends largely on where it is sold and the conditions under which it is traded. It is difficult, therefore, to derive a price broadly representative of the world market for sugar as such. Instead, the spot trade in raw sugar in London and New York, the principal international sugar markets, is regarded as the main market for determining the price of sugar.

Theoretical framework of the method of analysis

Comparative advantage, net social profitability and the domestic resource costs

A country has a comparative advantage in the production of a certain commodity if the social opportunity costs of producing an incremental unit of that commodity are less than its border price. The social opportunity cost of production of a commodity is the value of all factors of production used to produce the commodity in their best alternative use plus the value of all tradeable inputs measured in terms of their border prices.

This definition of comparative advantage in social terms is different from private profitability. An individual or firm makes private investment decisions on the basis of expected market prices for its inputs and outputs. In contrast, a national government acting in the interests of its populace would make its investment decisions on the basis of social prices of inputs and outputs. These social prices may differ from market prices and

consequently the net social profitability (NSP) of an activity may differ from its private profitability. The difference between social and private profitability can be positive, negative, or zero, depending on the balance of a variety of effects.

NSP is defined as the net gain (or loss) associated with an economic activity when all commodity outputs produced and material inputs and factors of production employed, are evaluated at their social opportunity costs (through the use of shadow prices) and when all external effects on the domestic economy are given a social valuation and included directly in the measure.

If: (a) all production units are profit maximisers, (b) no factor or product market distortion exists, (c) no economic rents are generated, (d) government tax or expenditure policies do not distort relative prices, (e) income redistribution measures are of no concern and (f) externalities are zero, then market prices of outputs and inputs would be equal to the shadow prices. And private and social profitability would be the same. Typically, few, if any, of the conditions listed above are satisfied in developing countries. A long list of policies and institutional considerations, such as legislated minimum wage levels, maximum interest ceilings, and over-valued exchange rates, introduce distortions resulting in a divergence between private market prices and social opportunity costs. As a result, considerable interest attaches to an examination of net social profitability of economic activities in developing countries, depending on government policies.

Basis for calculating comparative advantage

Project analysis is a method of presenting the choice between competing uses of resources in a convenient way such that the profitability of a project can be assessed from three different viewpoints: financial, economic and social (Squire and van der Tak 1975:15). The financial and economic analyses differ in only two respects: first, in terms of identifying relevant costs and benefits included in the analysis; and second, with respect to the prices used in the valuation of inputs and outputs. Social analysis is pursued when the major objective of a project is to assess the impact of income inequalities and distributional issues. For the purposes of this study the terms, economic and social analysis (profits) will be used interchangeably to imply economic analysis (that is, distributional issues are ignored).

The major objective is to investigate whether Papua New Guinea has a comparative advantage in producing sugar by calculating measures that indicate the (in)efficiency of resource use by the sugar industry. The decision rule in any project analysis using the benefit cost analysis (BCA) is to accept a project whenever the present value of benefits exceed the present value of costs.

The main measure used to evaluate whether Papua New Guinea has a comparative advantage in producing sugar—the DRC approach—is a trade-related extension of BCA. DRC analysis can therefore be used to identify potentially promising investment opportunities, but it captures only a time slice of a development process (takes a snapshot of costs and benefits) while benefit-cost analysis entails a discounted cash flow analysis. Efficient development can be thought of as a process that exploits current comparative advantage and invests the surplus to strengthen future comparative advantage (Tsakok 1990).

The decision rule in the DRC approach is that a country has a comparative (dis)advantage in the production of a particular commodity if the DRC ratio is (greater) less than one. The analysis is undertaken by embedding the DRC approach within a policy analysis matrix (PAM) framework.

The concept of a DRC ratio relates to a measure of real opportunity cost, in terms of total domestic resources, of producing (or saving) a net marginal unit of foreign exchange. By comparing it with some measure of the 'real' or 'accounting' exchange rate, it can be used as an investment criterion, just as the internal rate of return of a project is compared with some measure of the real rate of interest (Balassa 1974). A country has a comparative advantage (CA) in the production of a certain commodity if the social opportunity costs of producing an incremental unit of that commodity are less than its border price. The concept bears a close relationship to basic international trade considerations of comparative advantage (Bruno 1972).

Estimating policy impacts

Measures of CA are related to measures of policy incentives/transfers. The divergence between social and private profitability is a measure of policy effects induced by taxes and subsidies, import and exchange rate

policies, price policies, and/or market imperfections/failures. Comparison of policy transfers between systems with different outputs also requires ratios.

The concept of CA, as measured by the DRC ratio, is closely related to the effective rate of protection (ERP). The DRC compares the opportunity costs of domestic production to the net value added by that production process. The numerator is the total cost of domestic resources directly and indirectly applied and of non-traded inputs. The denominator is the value added in world prices. The DRC coefficient hence equals the ratio of total (direct and indirect) domestic factor costs at opportunity cost to value added at world market prices, in domestic currency. For an exported commodity, this indicator shows the extent to which the domestic cost of producing a unit of output differs from the value obtained from exporting it. If value added at world market prices is shown in foreign currency, then the DRC will show the domestic cost of foreign exchange earned. The coefficient should be calculated at a shadow exchange rate where this is different from the official exchange rate (OER). A coefficient less than one implies costs are less than returns, and its distance from unity indicates the degree of comparative advantage in production.

The ERP can be expressed as a coefficient known as the effective protection coefficient (EPC). It is measured by the ratio of value added expressed in domestic market prices to value added expressed in border prices. The concept of an effective tariff emanated from attempts by trade theorists to devise improved measures of the impact of commercial policy on world trade and of the implicit protection of value added in the presence of traded inputs (Bruno 1972). An ERP indicates the combined effects on a productive activity of a tariff or other form of protection on the output itself from that activity and on its inputs, and its influences on the producers' choice (Balassa and Associates 1971).

As Balassa and Associates explain, the nominal rate of protection (NRP) of a particular commodity is defined as the percentage excess of the domestic price over the world market price, resulting from the application of protective measures. When expressed in terms of a coefficient, NRP is termed the nominal protection coefficient (NPC) and is defined as the ratio of the domestic producer price of a commodity to its border price. The NPC indicates the impact of policy (and of market failures not corrected by efficient policy) causing a divergence between the world market prices and observed private domestic prices.

An EPC measures the policy transfer created by price policy interventions in the tradeable input and output markets. If greater (less) than unity, at the existing official exchange rate, protection measures provide potential (dis)incentives to produce the commodity or carry out the activity under consideration. An EPC less than unity indicates that protective measures discriminate against the commodity in question; if less than zero, it signifies an absolute loss of foreign exchange to the economy.

Monke and Pearson (1989) suggested that a profitability coefficient (PC) should be included as a measure of incentives to take into account domestic factor transfers. It is a proxy for net policy transfer and measures the incentive effects of all policies.

Finally, a subsidy ratio to producers (SRP) shows the net policy transfer as a proportion of total social revenues or the proportion of revenues in world prices that would be required if a single subsidy or tax were substituted for the entire set of actual commodity and macro policies.

Policy analysis matrix (PAM)

Analysis of trade policies in terms of their impact on commodity systems can be enhanced by using a PAM. It is a compromise between the desire for a theoretical model to describe the economy in detail and the need for insightful policy analysis that operates within the inevitable constraints of time and data availability. The theoretical basis for a PAM is the simple general equilibrium model of international trade rather than some welfare function (Monke and Pearson 1989).

A PAM is a concise description of a framework for thinking about policy analysis. It is a product of two identities, one defining profitability as the difference between revenues and costs, and the other measuring divergences (distorting policies and market failures) as the differences between observed values of the matrix parameters and their values if all divergences were removed. Through an evaluation of private and social revenues and costs, the PAM method is designed to clarify policy issues. It is well suited to (a) empirical analysis of agricultural price policy and farm incomes; (b) public investment policy and efficiency; and (c) policy on agricultural research and technological change (Monke and Pearson 1989).

The first row of the PAM (see Table 4.1) reflects private profitability, and contains values obtained from a financial analysis. It provides a measure of private competitiveness of the agricultural system given current technologies, output values, input costs plus the effects of all market failures and policies which create transfers in the system (Monke and Pearson 1989). A positive private profit (D) indicates the market competitiveness of the commodity system under investigation.

The second row contains measures of comparative advantage or social efficiency in the agricultural production system. Efficient outcomes are achieved when national resources are used in activities that create the highest levels of output and income. Social profitability, defined as H, is an efficiency measure because outputs, E, and inputs, F + G, are measured at prices which reflect scarcity values or social opportunity costs (Monke and Pearson 1989). These values are derived from an economic analysis. A social profit indicates that the system uses scarce resources efficiently and contributes to national income.

BCA normally focuses on estimating D and H which are the private and social (economic) profitability of a project, respectively. A PAM is taken a step further by enabling a comparison of private and social values (the vertical differences in values of rows 1 and 2). Net differences can be explained by the effects of a policy and/or existence of market failure.

Distorting policies are often introduced because decision makers are willing to accept some inefficiencies (and consequent slower growth of income) to further 'non-efficient objectives' (Monke and Pearson 1989). In the PAM, each entry measuring the effects of divergences (that is, I, J, K and L in Table 4.1) is disaggregated into three categories: (a) effects of market failures, (b) distorting policies and (c) efficient policies. Estimating a full PAM table is beyond the scope of this study, and the empirical work is restricted to deriving values for the cells in Table 4.1.

Measures of policy incentives in a PAM framework

Expressed mathematically, the DRC ratio for the jth product is $DRC_j = DC/NVA_j$, where DV is the opportunity cost of domestic production and NVA is the net value added. It can be derived from the PAM matrix in Table 4. 1 as G/(E – F).

Table 4.1 Illustrative policy analysis matrix for Papua New Guinea

	Tradeable outputs	Tradeable inputs	Domestic factors	Profits
Private	A	B	C	D
Social	E	F	G	H
Policy effects	I	J	K	L

Private profits, D, equal A minus B minus C
Social profits, H, equal E minus F minus G
Output transfers, I, equal A minus E
Input transfers, J, equal B minus F
Factor transfers, K, equal C minus G
Net transfers, L, equal D minus H; they also equal I minus J minus K.
Source: Monke and Pearson 1989. *The Policy Analysis Matrix for Agricultural Development*, Cornell University Press, London.

Also from the PAM matrix in Table 4.1, the NPCs for a tradeable input can be derived as A/E and B/F; the EPC is derived as (A – B)/(E – F); the PC is computed as (A – B – C)/(E – F – G), = D/H; and the SRP is defined as L/E, = (D – H)/E.

Financial and economic analysis of Ramu Sugar Limited

To calculate the comparative advantage of PNG in producing sugar, costs and benefits accrued in 1992 are analysed. There are two main reasons for choosing this year. First, the data on costs and returns from the RSL profit and loss accounts are more detailed than in previous years. Second, it provides the most up-to-date information on the sugar industry, and is more likely to be representative of the costs and benefits accrued in the short to medium term of the life of the project.

A focus on one year implies a static equilibrium in the sugar industry. This forms the basis of the difference between this study and that of a more common assessment of a project which entails discounted cash flow analysis. Before undertaking this task, an attempt is first made to describe the major tasks of the PAM as handled in the case of RSL.

Major tasks in estimating the PAM

The four major activities in the sugar industry in PNG are represented in Figure 4.1.

Farm production. This stage covers the production of sugarcane for which data on inputs and outputs were collected. In the case of RSL, it refers to all activities from the growing of cane to its harvesting. Evaluation of production alone would stop at the farm gate, but measurement of comparative advantage should encompass all activities until the product reaches the consumer, entailing three more stages.

Farm-to-factory. Sugarcane is transported from the field to the factory, that is, from farm gate to the mill for processing. Activities that need to be costed include storage, handling and transport.

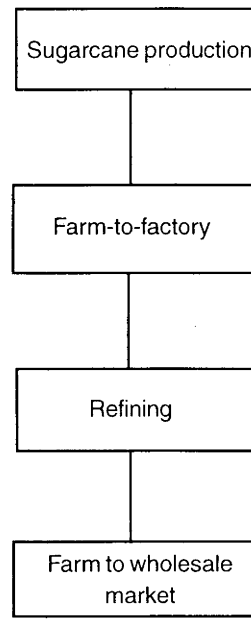
Refining. Sugarcane is processed into a consumer-acceptable form and involves physical transformation, packing, handling and quality control. Apart from mill white sugar, the two main by-products are molasses and bagasse. Molasses (uncrystallised syrup which is the residue after most of the sugar has been extracted) is fermented to produce ethanol. The plant has the capacity to produce 30,000 L of ethanol per day. Bagasse is the fibrous residue after crushing used as a fuel to generate steam and electricity for the factory and township.

Factory-to-wholesale market. Sugar and by-products are moved from the factory to wholesale, retail or export outlets, entailing various transport and marketing costs.

A physical input-output table was developed that describes the major farming activities. It includes aggregate farm management data on yields, cropping calendars, labour and machinery use, and use of other purchased inputs. Data on costs were obtained from the RSL profit and loss accounts. A common numeraire is achieved by expressing all costs are given either in actual value or in terms of volume of mill white sugar.

The major tradeable commodities from the activities of RSL are mill white sugar, ethanol and bagasse. The social prices of these commodities were based on the Caribbean (New York) spot market for refined sugar, using the Caribbean port prices. These world market prices were then converted to domestic currency by multiplying by the official exchange rate. The private prices of sugar are the domestic ones set by the price controller using a formula agreed upon by the government and RSL.

Figure 4.1 Structure of the sugar commodity system in Papua New Guinea



Source: Adapted from Monke, E.A and Pearson, S.R, 1989. *The Policy Analysis Matrix for Agricultural Development*, Cornell University Press, London.

The non-traded inputs include machine use, transportation, storage, marketing and processing activities. The process of decomposition involves decomposing non-traded inputs into traded elements (machines, fuel, repairs) and non-traded primary factors (labour and capital). This task demands a great deal of detailed information. Due to the fact that data required for this task were either sketchy or not made available for this study, a similar study is reviewed here to explain how it would have been performed were the necessary data available.

Akrasanee and Wattananukit (1975) carried out a DRC study of rice production in Thailand. In their study, processing and transportation costs were estimated from the f.o.b. price of milled rice less taxes and the equivalent farm-gate price of milled rice, using the standard conversion

ratio of 3 to 2 between paddy and milled rice. Eighty per cent was considered to be domestic cost, and the remaining 20 per cent foreign cost. The domestic cost was then divided into 60 per cent labour cost and 40 per cent capital cost.

The main source of data used in this study is the profit and loss accounts of RSL for 1992. The data are presented in an aggregate form and, unfortunately, a detailed breakdown of the costs was not available. Consequently, the tasks of constructing the PAM were not carried out in the usual manner. Instead, Elek's (1991) study on structural adjustment in Papua New Guinea and Fleming and Antony's (1993) study on smallholder coffee production were used for two purposes. They were, first, to decompose costs into their foreign and domestic components and, second, in the case of production costs to disaggregate the costs into their various cost components as well as to allocate into labour cost and other costs. The empirical estimates from these studies were used, based on the procedure followed by Akrasanee and Wattananukit (1975).

Akrasanee and Wattananukit estimated prices for non-traded factors in the following manner. The cost of labour was divided into two components: labour used in the production of paddy, and labour employed in the processing, transportation and production of inputs. The former was obtained by multiplying the wage rate by the number of man-days of hired and family labour. The wage rate used was the weighted average daily wage on an annual basis of one hired labourer. Labour costs of other inputs were part of the added cost of imported inputs and part of the non-tradeable inputs. The added cost is the cost involved from the point of import to the user, net of taxes.

Capital costs were divided into two components similar to those of labour costs. The direct capital cost of paddy production is the opportunity cost of funds invested in the production process plus depreciation of fixed assets. The price of capital was estimated to be 15 per cent, and the depreciation rate was set at 10 per cent. The other capital costs (40 per cent) arise from the processing, transportation, storage and marketing, as discussed above. The land cost was approximated by the net revenue from growing an alternative crop evaluated at market prices (Akrasanee and Wattananukit 1975:182).

The incidence of seasonal labour migration from the Highlands to the Ramu valley during the planting and harvesting periods ensures that the wage rate paid is a good estimate of the shadow wage rate. However, lack of information on that wage rate meant a proxy had to be used.

Therefore, a measure of returns to labour obtained in a study by Fleming and Antony (1993) is used to approximate the opportunity cost of labour used in the production and harvesting of sugarcane. The labour costs of other inputs were already specified in the RSL profit and loss accounts, and therefore did not need to be estimated.

The rental value of land is used in the financial analysis. The best alternative use of this land would most likely be food production for subsistence and sale in the roadside market. Unfortunately, there have not been any estimates of the returns to land and labour under food crop production, or for that matter any other potential activities, in the study area. A proxy was again sought, and Overfield's (1993) study of coffee production in Benabena district in the Eastern Highlands is used as the opportunity cost of land under sugarcane. While it may be argued that these two study areas are very different in terms of climate, vegetation, population density and access to services and markets, the figures are thought to be reasonably representative. Nevertheless, sensitivity analysis was undertaken on these estimates to test their impact on study results, as discussed below.

Capital cost was estimated by using the depreciation cost for the year 1992 from the RSL profit and loss accounts for that year. It could be argued that this is a historical cost, and not an estimate of ongoing capital requirement to maintain existing sugar operations. However, again, it is the best estimate available. Its use implies an assumption that depreciation allowances made by RSL are good estimates of annualised current and future capital needs in the industry.

Intangible and indirect benefits and costs were merely identified and discussed elsewhere in qualitative terms (Peter 1993:78-9).

Financial analysis

The numeraire in the financial analysis of RSL is the financial DRC ratio for producing sugar. The benefit and cost calculations are done on the basis of value in kina of a tonne of sugar using actual market prices, assuming that 1992 price relativities will prevail in the future.

Import parity prices of the tradeable inputs could not be calculated due to the unavailability of data. The costs of tradeable inputs are the c.i.f. prices of the inputs net of import duty, plus domestic transport, handling and storage costs. For domestic inputs, the material cost is the price of the input less any indirect taxes.

The price of land use in the case of RSL is the rental value of land, which was K140/ha at the time of analysis. This figure was arrived at by the company by estimating the cost of getting cane from the furthest potential cane-growing area to the factory.

Information on the number of workers, type of labour and wage level of each type of labour was either unavailable or incomplete. The cost of labour therefore could not be calculated on the basis of the amount actually paid to hired labour in wages. The labour cost used in this study was obtained from the RSL profit and loss accounts where the labour cost component was a separate cost item under each department and section. An exception is the cost of producing sugarcane, where the aggregated total cost figure was given. Elek's (1991) study was used to apportion the cost components while the study by Fleming and Antony (1993) was used to calculate the proportion of cost attributed to labour in addition to determining domestic and foreign components.

Costs arising from taxes and subsidies are included in the costs in the RSL profit and loss accounts and, therefore are included in the financial analysis. The spare parts have a tariff of 25 per cent on the total import value while agricultural inputs have a 10 per cent tariff on their total import value.

Economic analysis

The numeraire in the economic analysis is the economic DRC ratio to produce sugar in Papua New Guinea. Indirect taxes were excluded from the economic analysis. As stated above, the spare parts have a tariff of 25 per cent on the total import value while agricultural inputs have a 10 per cent tariff on the total import value. Average imported components for the different categories of inputs for the years 1984 to 1988 was used adjust for tariff effects. To avoid double-counting, the tariff equivalent values for agricultural production and milling inputs were subtracted from the total import cost rather than determining import parity farm-gate prices.

Depreciation estimates were based on values given for depreciation in the RSL profit and loss accounts which are derived using the 'straight-line' depreciation method.

It is difficult to gauge the appropriate shadow exchange rate to use in economic analysis. The simple approach adopted here is to assume it is equal to the OER, and undertake sensitivity analysis around this value. A 'hard kina' policy was adopted and implemented in Papua New Guinea

from independence in 1975, using monetary and fiscal policies to maintain external and internal balances. A change was made to this policy in 1983 with a 10 per cent devaluation, followed by a further 10 per cent devaluation in 1990. The kina was again devalued by 12 per cent in September 1994, forced by a balance of payment crisis, and has continued to decline in value since then. Study estimates are based on the exchange rate prevailing at the time of the study, and sensitivity analyses are undertaken using shadow exchange rates which could conceivably prevail in the future.

Results

Empirical results are presented and discussed in this section. The PAM framework used in this study to tabulate the results of the private and economic profitability analyses lends itself to the estimation of the divergences between the private and social (economic) prices, termed as policy effects in the PAM table. Finally, the policy incentive measures are also derived using the variables in the PAM table. The results of both the financial and economic analyses for this study are shown in Table 4.2.

Table 4.2 The PAM table for Papua New Guinea

	Tradeable outputs (K million)	Tradeable inputs (K million)	Domestic factors (K million)	Profits (K million)
Private	33.8	6.0	19.3	8.4
Social	7.2	5.2	19.3	–17.3
Policy effects	26.5	0.8	0.0	25.7

The results for the private profitability of RSL presented in the first row of Table 4.2 indicate the market competitiveness of sugar production, given input and output prices, technologies and government policies.

The second row refers to valuations that reflect comparative advantage, or economic efficiency, in sugar production. The figure in the right-hand column (–K17.3 million) indicates that resources are used in sugar activities at a large social loss: they are misallocated in the sugar industry.

The vertical differences allow comparisons of the private and social values. Net differences can be explained by the effects of a policy and/or existence of market failure. The vertical differences in this study are all positive. Supposing all the factors of production were valued at their opportunity cost, one would expect economic values to be greater than the negative, leading to negative differences between the private and social prices. These divergences can be obtained from Table 4.2.

The financial DRC ratio found using the PAM equals the cost of domestic factors of production valued at financial prices divided by the value added at financial prices. In turn, the economic DRC ratio is calculated in a similar manner but using efficiency prices. Results are as follows:

Financial DRC ratio = C/(A – B) = (K19.3 million)/(K33.8 million – K6.0 million) = 0.68.

Economic DRC ratio = G/(E – F) = (K19.3 million)/(K7.2 million – K5.2 million) = 9.60.

These results indicate the competitiveness of the sugar industry under the current sugar policy, where imports are banned and the domestic industry is supplied by one producer, RSL. Specifically, the DRC ratio of 0.68 indicates that the company saves foreign exchange from local production, because the opportunity cost of its domestic resources is less than the net foreign exchange it saves in substituting for imports. The economic DRC ratio of 9.60, on the other hand, indicates that the Papua New Guinea economy is incurring costs in excess of what it saves from the production in terms of net foreign exchange. In this case, the Papua New Guinea economy is incurring costs almost 10 times in excess of what it saves from producing sugar domestically.

If NPC is greater than unity, domestic producers or intermediaries are receiving a higher price after intervention than they would without intervention. This is called positive protection. An NPC greater than unity denotes a negative protection for consumers. If NPC is less than unity, then the reverse structure of protection is in force. Protection is negative, and the producer or intermediary is being discriminated against, while the consumer is being favoured. Finally, if NPC is equal to unity, the structure of protection is neutral. Producers, intermediaries, and consumers are facing domestic prices that are equal to the border prices that would have

been faced without intervention. In sum, the greater the divergence of the NPC from unity, the greater the effect of policy on altering price structures and the incentives to produce or consume the product.

The NPC for tradeable sugar output = A/E = (K33.8 million)/(K7.2 million) = 4.7. This value reflects the substantial impact that the import substitution policy has on price structures and incentives to produce and consume sugar in PNG. Sugar producers receive a far higher price under the protection policy than they would without the intervention. The consumers, however, lose by having to pay a higher price for sugar; for them, the protection is negative.

Another measure of incentives is the EPC. If EPC is greater than unity, then domestic producers are receiving a greater return on their resources, given intervention, than they would without intervention. They are enjoying positive protection. A positive EPC, however, denotes a potential incentive, not an actual one. If EPC is less than unity, producers could have received a higher return if they faced border prices instead of domestic prices on both inputs and outputs. They are receiving negative protection. Again, a negative EPC denotes a potential disincentive, and not an actual one. If EPC equals unity, the structure of protection is neutral. Producers are neither favoured nor discriminated against.

The EPC = (A – B)/(E – F), = (K33.8 million – K6.0 million)/(K7.2 million – K5.2 million), = 13.8. This high value indicates that RSL earns a much greater return as a result of intervention. Thus, consumers are discriminated against while RSL is favoured.

PC can serve as a proxy for net policy transfer by measuring the incentive effects of all policies. It is measured as:

PC = (A – B – C)/(E – F – G) = D/H = (K11.5 million)/(K9.2 million) = 1.25.

Sensitivity analysis

Estimates of long-run world prices for output (and exchange rates), production costs and the cost of capital are usually the most uncertain in agricultural industries producing tradeable commodities, and typically receive most attention in sensitivity analyses. In the sensitivity analyses that follow, attention is also given to a fourth variable; as mentioned above, the opportunity cost of using land for sugar production is quite uncertain. A summary of the results of the sensitivity analysis on the major variables in the economic analysis are presented in Table 4.3.

World sugar market prices under liberalised conditions

Several modelling approaches have shown that domestic policies in developed countries have markedly depressed world market prices. In a recent survey of estimates of impacts of likely liberalisation of world markets as a result of the Uruguay round of GATT negotiations, Martin and Winters (1996:20) reported a range of price changes between +1.5 per cent and -10.2 per cent. These changes are much less than might be expected from a full liberalisation of the world market for which estimates of price declines have been as high as 53 per cent (Roningen and Dixit 1989).

Sensitivity tests were carried out on the assumption that a liberalised world sugar market would increase world market price by 11 per cent (the most realistic upper limit under current liberalisation plans), 35 per cent (estimated by Borrell and Duncan (1990) under a particular scenario for liberalisation greater than that currently planned) and 53 per cent. The sensitivity tests on these three price scenarios yielded DRC ratios of 6.88, 4.00 and 2.67, respectively (Table 4.3). The conclusion from this analysis is that, even under the most optimistic scenario of liberalisation of the world sugar market, Papua New Guinea would not gain a comparative advantage as a sugar producer. Instead, it would continue to use at least twice as many domestic resources to save a unit of foreign exchange.

Opportunity cost of land

Land is the second variable tested for its impact on the DRC ratio when its values are changed. The sensitivity test is carried out on the value of land in its best alternative use which includes land under a cash crop integrated with a food crop garden. Overfield (1993) estimated the returns to land under coffee to be lower than food when the value of subsistence production is included. The average returns to land under coffee were K1092/ha while returns to land under food were K763/ha (excluding subsistence production) and K2887/ha (including subsistence production). Overfield's estimates are used as the basis for sensitivity analysis here.

The results of the sensitivity test on the opportunity cost of land, shown in Table 4.3, lead to the conclusion that the opportunity cost of using the land for sugar production is high, confirmed by DRC ratios of 12.39, 16.65 and 28.94 for the different land uses. The magnitudes of the ratios imply that there are more efficient uses of the land than the current use of producing sugarcane.

Results of sensitivity tests on the official exchange rate

From Stein (1991) and in the wake of currency devaluations following the recent financial crisis, it is concluded that the domestic currency used in the study may well be overvalued. A sensitivity test on a devalued currency is therefore warranted to determine the changes to the DRC ratio.

From Table 4.3, 30, 50 and 80 per cent devaluation of the currency yields DRC ratios of 5.40, 4.18 and 3.12, respectively. These results show that, when the currency is devalued to reflect better the shadow exchange rate, the comparative disadvantage to produce sugar decreases. The

Table 4.3 Summary of the sensitivity analysis results for the DRC ratio

Parameters	World market prices (WMP)	Land	Official exchange exchange rate (OER)	Depreciation
Current price	9.60	9.60	9.60	9.60
11% increase in WMP	6.88	-	-	-
35% increase in WMP	4.00	-	-	-
53% increase in WMP	2.67	-	-	-
Land under coffee	-	12.39	-	-
Food excl. subsistence	-	16.65	-	-
Food incl. subsistence	-	28.94	-	-
30% devaluation (OER)	-	-	5.40	-
50% devaluation (OER)	-	-	4.18	-
80% devaluation (OER)	-	-	3.12	-
80% less depreciation	-	-	-	9.51
50% less depreciation	-	-	-	9.14
30% cost overrun	-	-	-	9.88
50% cost overrun	-	-	-	10.06

comparative disadvantage to produce sugar even if what would appear to be an unrealistically high exchange rate devaluation (80 per cent) were to be realised.

Depreciation of capital assets of RSL

Cost overestimation/overrun is a common variable for sensitivity tests and is included in this study for depreciation. The cost of capital per unit of throughput is likely to have a lower cost as the industry increases its throughput, thereby decreasing its unit cost assuming there is no major capital investment in the near future. But it is also possible that capital costs are being underestimated so sensitivity tests were carried out for both increased and decreased depreciation.

Results of the sensitivity tests show that, even if the costs of capital to continue normal operations are overestimated, a 50 per cent overestimation still yields a very high DRC ratio of 9.14. Assuming a capital cost overrun of 50 per cent, the DRC ratio would rise to 10.06. That is, results of this sensitivity analysis show that the DRC ratio is insensitive to changes in depreciation costs. The tentative conclusion is that RSL is a capital-intensive, high-cost industry which can not appreciably improve its comparative advantage by reducing capital costs.

Policy and research implications

RSL has now been in operation for more than a decade. The government initially agreed to offer infant-industry protection to the company for five years from the year of its first significant production (1983). A pricing formula was put in place to support this policy. On its part, the company was expected to increase production and improve efficiency to enable it to supply the domestic market as well as export surplus production to international markets. The aim of meeting domestic demand has been achieved and the infant-industry status is long overdue to be removed, yet the company continues to enjoy protection through the prohibition of imports of sugar.

Among the many policy tools available, the DRC approach was selected to assess the comparative advantage in producing sugar in Papua New Guinea. Results show that, in financial terms (that is, from the viewpoint of RSL), sugar production is a competitive agricultural system under the

current economic structure. This is evident from the private profit of K8.44 million and a financial DRC ratio of 0.68. The economic results are starkly to the contrary: the DRC ratio is 9.60.

Various sensitivity analyses show that even if the assumptions underlying the analysis are too pessimistic, Papua New Guinea still does not have a comparative advantage in sugar production. In particular, even if the world sugar market was liberalised, Papua New Guinea would not benefit from the liberalisation as a sugar producer to the extent that it would have a comparative advantage in sugar production. Although the DRC ratio decreases with a liberalised world sugar market, it remains well above unity. It is concluded that sugar production should cease unless other social benefits of the industry, not quantified in this study, are felt by the government to outweigh the economic costs.

Women's time allocation in rural areas in Solomon Islands

Sama Shrestha

Intensification of cash cropping has put pressure on land and labour in the rural economy in Solomon Islands. The effects of more cash cropping on food gardening are

- smaller food gardens
- a shift of food gardens to disadvantaged areas such as marginal lands and steeper slopes
- reduced fallow periods between successive food garden cropping phases which will result in declining productivity as soil fertility declines in the long run
- increased distance of food gardens from the settlement.

As food gardening is predominantly women's responsibility, changes in food gardens are likely to affect women's time allocation. Jones, Fleming and Hardaker (1988) found that men's time allocated to food gardening was very high in Haimarao and Gwai'au where subsistence production predominated (for example, 98 per cent of men's agricultural time in Gwai'au was for food gardening). On the other hand, men's time allocated to food gardening was relatively minor in Tamboko and Manakwai, where cash crop production predominated. In cash-cropping villages women had responsibility for food gardening and marketing, as well as being involved in cash crop production (Hetler and Khoo 1987). Women contributed one-third of labour used in copra production and nearly half that used in cocoa production (Jones, Fleming and Hardaker 1988).

Despite the transition to cash cropping, food garden production is still important to the overall economy of Solomon Islands. Preference for a traditional diet, lack of purchasing power to obtain import substitutes and the demand for traditional products for religious festivals are the main

reasons for continued production of food garden output (Fleming 1989). Although the variety of food garden production in Tamboko had declined, food gardens products were the main source of cash income in 1985-86 (Kunert 1986). Despite higher returns from cash crops, villagers preferred to maintain food gardening to protect against wide fluctuations in cash crop prices and yields.

Hughes (1985) found that leisure time was being eroded with modernisation. Women's work based at home had increased with an increase in cash cropping. This was confirmed in the SP2 results which indicated that more time was being allocated to cash cropping in Tamboko and Manakwai compared with Haimarao where the time allocated to home duties was the lowest.

Women in Solomon Islands already spend more time than men on economic activities (Hetler and Khoo 1987), and they were found to have 37 per cent less leisure time than men (Jones, Fleming and Hardaker 1988). Will an increase in household income from cash cropping necessarily lighten the workload for women? The economic literature suggests women's workload can be adversely affected when development policies are introduced without due consideration to women's welfare (Boserup 1970; ISIS 1983; Charlton 1984; Swantz 1985). Thus, it is important to evaluate the effect of the transition from food gardening to cash crop production on women's time allocation. In this evaluation both economic and non-economic factors affecting household behaviour need to be examined.

Objectives and rationale for examining women's work

In light of the above discussion, the research questions to be addressed are

- has the adoption of cash crop production affected women's welfare in terms of their workload?
- is the labour for cash cropping coming from?
- Is it by taking on additional workload?
- has it been made possible by changes in labour allocation to food gardening, work at home and leisure?

These are important considerations as the literature suggests that women's workload can increase substantially when development policies are introduced without due consideration of such questions. Accordingly, the research aim was to evaluate the effects of cash crop production on women's time use in various activities and their economic implications.

There are four main reasons for examining women's work separately. First, poor women tend to work longer hours and have less leisure time than poor men (Bruce 1989). When these working hours are assigned an economic value and added to the household's cash income, the contribution of poor women and children to household income usually becomes greater than that of poor men (Acharya and Bennett 1982; King and Evenson 1983). Second, increases in the burden of household work, such as additional children, tend to change women's and older children's time allocation to market work, housework and leisure, but not that of men (Buvinic 1983). Third, women in industrialised countries trade off between market work and child care, but in developing countries there is no evidence of such trade-off (Buvinic 1983). When women enter the labour market, it is leisure time rather than production time that is reduced (Mueller 1984; Khandker 1988). Finally, although women's role as producers and participants in economic growth has been recognised, their production activities still occur within a dualistic economy where women are relegated to gender-specific traditional work with little access to productive resources (Rogers 1979). Conventional anti-poverty policies that do not place specific emphasis on gender tend to ignore the large subgroup of women who work at gender-segregated tasks (Buvinic 1983, 1986).

A study of time allocation data is appropriate in three main ways for modelling economic activities in developing countries. First, the market sector in developing countries is relatively small compared with the household economy where much of the output is being produced using family-owned inputs. The conventional methods of national accounting ignore such inputs and outputs and, hence, do not depict the real value of the economic output. Although the national accounts include some of the goods and services produced and consumed within the household, other activities vital to the livelihood of the rural economy, particularly those of women, are excluded. For example, the labour required for gathering fuelwood and water, activities based at home and supervision of children

are not included in such accounts. Time allocation data have been used in some cases to augment conventional economic accounting in estimating the real value of output in the economy as a whole (Buvinic 1983).

Second, the time of household members is itself a factor of production. Detailed information on patterns of time allocation in rural societies can give new insights into the rural unemployment problem by showing that rural poverty is not characterised by open unemployment (no work to do) nor even by underemployment (not enough work to do), but rather by 'a lot of work to do' with very low returns (White 1980). In the smallholder agricultural system, one of the major constraints to change and adoption of innovations is lack of time (Momsen 1986). Hence, time allocation studies can be useful in illuminating what really goes on in the household, enabling appropriate employment strategies and policy measures to be formulated. For example, disaggregated study of household time allocation may reveal that women are unable to participate in income-generating activities due to their long hours involved in cooking and preparation of food. In these cases, cooking time could often be substantially reduced by the introduction of simple household technology.

Finally, time allocation studies have been widely applied in modelling household behaviour (Juster and Stafford 1991). Such modelling studies give insights into the division of labour within households by gender and other demographic characteristics. Micro-level analysis is useful in examining the general well-being of individual members of the household. This information can also be valuable in designing programs that help to increase household income by

- reducing the time required for household production
- increasing the efficiency, output and returns of economic activities in which women currently engage
- transforming subsistence activities into income-generating activities
- creating new employment opportunities for women (Buvinic 1983).

There is apparently only one study of women's time allocation in Solomon Islands, carried out in Dala, North Malaita with a sample of only eight women (Warmke 1985). It showed that most of women's time is allocated to food gardening activities. The report is of a descriptive nature and reveals limited information. The competition between cash cropping and food gardening in land use in Solomon Islands has been analysed by Jones,

Fleming and Hardaker (1988), Fleming (1989), Frazer (1986) and Bayliss-Smith (1986) but these authors did not analyse the competition for labour use. There is a lack of information on factors determining labour allocation, in particular women's labour allocation. The present study is an attempt to assess the effects of competition for women's labour in the rural sector of Solomon Islands.

Women's role and contributions in the Solomon Islands farming system

In the ethnographic and anthropological literature, Melanesian women are considered to be the agriculturalists: they are described as the 'producers' and men as the 'transactors' (Slatter 1984). In 1976, female labour force participation in the agricultural sector in Melanesia was put at 56 per cent (Hetler and Khoo 1987). The reported time allocation patterns in the agriculture sector showed that women spend more time than men on economic activities. They contribute in the household through

- non-market production (including household and garden work)
- family enterprise as unpaid family labour (for example, in cash crop production)
- cash income outside the family (including the marketing of food and cash crops).

Food gardening is not exclusively women's work, but women spend more of their time than men in these activities. Melanesian women are responsible for planting, weeding, general maintenance, harvesting and transportation of the produce. Men's activities include clearing the forest for new gardens and building fences (Ward and Proctor 1980).

Analysis of the data collected in 1985-86 for the SP2 suggests that women's work loads had increased with the expansion of cash cropping. This is because women also undertake a significant portion of the work in cash crop production. Hetler and Khoo (1987) found that modernisation had placed heavy work burdens on women that were not present in earlier years. Slatter (1984) claimed that the introduction of cash crops had expanded women's roles in both food gardening and cash cropping in Melanesia and Polynesia. Moreover, most home-based activities are mainly carried out by women. They are responsible for general domestic duties, collecting water and fuelwood and child rearing.

Development policies for women in Solomon Islands

The Solomon Islands National Development Plan 1985-89 listed the following objectives related to women representative of development aims

- to promote women's contribution in policy planning
- to disseminate information and resources on the welfare of women, and the family
- to improve women's skill and knowledge for their participation in development.

At the time that plan was formulated, the government apparently acknowledged the need to enhance women's skills in agricultural production to avoid future food shortages and reduce food imports (Wilson 1986). However, there was no holistic policy for integrating women in the development process. Integrating women's perspectives was seen as an extra activity rather than an essential part of the overall strategy, and activities were constrained by limited budgets and shortages of staff (Wilson 1986).

Liberal western feminist thought appears to be the guiding force in much of the women-in-development literature, and has influenced government policies towards women in Solomon Islands. Yet the policy guidelines derived from women-in-development approaches may not be appropriate in Solomon Islands. For example, although the need for improving women's participation in the development process is recognised in the national policy, little attention is paid to preserving traditional values. Hence, it can be argued that there has been some erosion of the traditional rights of women (for example, the matrilineal land heritage) through policy neglect of desirable traditional customs.

To conclude, since the 1970s the failure to recognise women's role in national development, particularly in the rural sector, has had detrimental effects on women and on the development process itself. The need to integrate women's considerations is not questioned in current development thinking (at least in theory). But, despite some attempts to integrate women's issues in development in recent times, the question of how to integrate women's activities successfully in the development process has not been satisfactorily resolved.

Analysis based on the new household economic theory

Application

The new household economic theory, originally proposed by Becker (1965), has been adapted to a wide range of problems. In this section, some applications are discussed which are relevant to this study.

Pollak and Wachter (1975) stated that time spent in many household activities is a direct source of utility (or disutility) as well as an input into the production of a commodity. Goods produced in the household for own consumption, thereby entering directly into the household's utility function, are called Z-goods. The prices of Z-goods depend not only on the prices of market goods, and on household technology, but also on the household's time allocation preference (Delforce 1990). Thus, Pollack and Wachter suggested that the demand for a commodity should be viewed as a function of prices of goods, the wage rate and non-labour income.

Becker's concept of basic commodities produced by the household is too restrictive as it seems to apply only in cases where there is an input of market goods. Time may be spent in ways that give utility but do not require any input of market goods at all. Furthermore, some activities, such as supervising children, do not require any exclusive allocation of time since they can be carried out during the time that is already allocated to another activity. The incorporation of joint production in time allocation analysis is discussed by Pollack and Wachter.

One of the main deficiencies of Becker's theory is its inability to distinguish between work at home and leisure. Mincer (1962) pointed out that, at least in studying women's time allocation, it is important to distinguish between these two uses of time. Aggregation of these two components into one entity as non-market time is difficult to justify, and 'the theory of time allocation in its current form is of little help...in the analysis of time budget data' (Gronau 1980:43). Gronau argued that such an aggregation is justified only if

- these elements react similarly to changes in the socioeconomic environment; and
- their relative prices are constant.

Gronau's research on time allocation by households found evidence to contradict both assumptions. Time allocation studies reveal that work at home and leisure are affected differently by changes in socio-economic variables, wage rate, number of children etc. Thus, the distinction should be a prerequisite for any further investigation of time use patterns.

Gronau defined work at home as generating goods and services that have close substitutes in the market: it is an activity one would rather have somebody else do. In the extreme case, work at home and work in the market are perfect substitutes in regard to the utility they generate. Leisure, on the other hand, would be impossible to enjoy through a surrogate and has poor market substitutes (Gronau 1980: 48). Taking this approach to analysis, Gronau suggested that work at home has more in common with work in the market than with leisure.

Intra-household differences in earning power are not accommodated in the basic theory. The assumption that a household's time can be reasonably valued at a fixed and uniform wage rate has been abandoned in the applications of the theory (Gronau 1980; Yotopoulos and Mergos 1986). There is a marked difference in the wage rate between males and females in most economies. Low (1986), working in South Africa, accommodated the difference in wages between the sexes in his analysis of household members engaging in several economic activities. He was able to depict graphically the high migration among men in that region because the return to their labour was higher than engaging in subsistence or cash cropping. Low's analysis emphasises the logic of comparative advantage in determining the division of labour within a household. Hence, the choice between subsistence production, cash crop production, wage employment and household work is a function of individual and household characteristics as well as of relative prices, wages and productivities.

Appropriateness of the household as a unit of analysis of women's activities

Economists theorise about, and model, household behaviour for a wide range of diagnostic and predictive purposes. The household is an important unit for analysing the welfare of women because housework constitutes a large part of women's lives. Research on women from the perspective of the household has helped bring women's issues into the policy-making

process. There are, however, some grounds to criticise the focus on the household in the new household economic theory in regard to research on women's issues.

First, the definition of a household as a social and economic entity with clearly defined boundaries, organised independently of other households and actors in the economy, is problematic (Evans 1989). This definition does not recognise the inter-household social and economic exchange that could be an important source of support for women. In particular, women of several households tend to engage in joint production activities. Hughes (1985) argued that the household is neither a traditional unit nor traditionally important in the South Pacific. Numbers of households in the South Pacific may be linked by kinship ties or common access to shared means of production. Hence, a narrow definition of the household can obscure critical aspects of intra- and inter-household exchange which are essential sources of factors of production and consumption goods.

Second, there is an analytical problem in seeing the household as a decision-making unit, behaving according to the rule of maximisation of household utility. The interests of household members are presumably incorporated in a joint utility function, achieved through the assumption of either total or partial altruism among household members articulated by a dominant household head (usually male). It is assumed that usually the head of the household makes choices on behalf of all household members. This assumption does not recognise different preferences of individual members. A wife often exhibits views different from, and sometimes opposite to, those of her husband in household decisions such as household budgeting, workload and reproduction behaviour (Bruce 1989; Evans 1989; Kabeer 1991). The emphasis on decision outcomes in the new household economic theory, rather than on the decision-making process itself, ignores the possibility of conflict between family members in decision making (Buvinic 1983).

Folbre (1986) argued that the assumption of a joint utility function prevents exploration of conditions of unequal exchange and exploitation between family members. Taking family reciprocity as given eliminates the possibility that household choices are motivated by anything other than changes in external variables, such as prices and income.

Finally, in the new household economic theory family labour time is treated like any other factor of production which can be flexibly allocated on the basis of its comparative advantage in market and non-market

activities. However, family labour is not homogeneous and is not perfectly substitutable within and between the household and market place. Furthermore, the division of labour within a household is normally based on gender. There are also non-economic and ideological factors that discriminate between male and female labour markets with the result that their labour is valued differently in market and non-market sectors (Evans 1989).

Given these reservations to using the household as a unit of analysis in assessing women's welfare, its application in this study need to be justified. Some of the reasons are as follows. A strong cultural bias supports the analytic and practical impetus to unify individuals into households. Structural parameters such as land tenure rights, access to resource and socio-economic position are defined in regard to households. Policymakers also consider the household as a single entity to which policy interventions are to be directed.

The focus of this research relates to women's role in production, in particular identifying the determinants of women's time allocations to rural household activities. Research inquiries can be adequately explained by partial analysis of a household for which reliance on household economic theory is adequate (Bruce 1989). The more complex intra-household bargaining model, suggested for analysing women's issues, is mainly used in examining the internal conflict within the household.

Review of studies of women's time allocation patterns

Time allocation studies have been carried out for a wide range of activities in industrialised countries but fewer studies have been done in developing countries. This review consists mainly of time allocation patterns by households in developing countries. The prime interest is in the determinants of time allocation by family members for home production, farm activities, market production and leisure.

Bloch (1973) and Gronau (1976) studied the time allocation patterns of American and Israeli families, respectively. The study of Israeli families indicated that an increase in the wives' education was accompanied by an increase in their labour market participation. Mueller (1984) found a similar result for rural Botswana. Increased market participation is made possible by less work at home, leaving leisure unaffected.

Bloch (1973) and Gronau (1980) found that, when women were employed, a major determinant of their time allocation was their wage rate. An increase in wives' wage rates led to an increase in their labour force participation; which reduced their time allocated to work at home and leisure. Employed women had less leisure than unemployed ones. An increase in wives' wage rates did not affect their husbands' work in the market but led to increased work at home for him. On the other hand, an increase in husbands' wage rates resulted in increased market participation by husbands and reduced market participation by wives. Gronau (1980) claimed that an increase in husbands' wage rates did not affect the wives' work at home, and increases wives' leisure.

Bloch (1973) found that an increase in non-labour income reduced husbands' and wives' supply of labour to the market and home production activities, and thus increased leisure. However, in contrast, Gronau (1980) found that an increase in unearned income and husbands' wage rates did not affect employed women's work at home although there was a positive effect on leisure. Both of these studies were carried out for US households.

Women in female-headed households tend to spend more time on market work as these households are generally poorer than male-headed households. In such cases, an increased participation in the market is achieved at the expense of leisure (Mueller 1984).

The presence of children in the household results in a transfer of the mother's time from the labour market to home production. Usually leisure is also reduced as the amount of time transferred from the labour market falls short of the additional time required to take care of the children (Bloch 1973; Gronau 1976, 1980; Mueller 1984). These patterns have been observed for developed as well as developing countries. In the case of industrial countries, household work diminishes as the child grows older and enters school, but this does not lead to an increase in leisure as the time saved in work at home is diverted to the market (King and Evenson 1983).

Generally, family members in large households with children have less leisure time and more work in the family enterprise (Mueller 1984). However, King and Evenson (1983) found that, in the Philippines, total market time of mothers in larger households was greater than in smaller households. Moreover, parents with many children spent less time caring for their children than parents with fewer children. Fathers with many children enjoyed more leisure time. This result is not surprising, as larger households often have older children who can substitute for parents' labour

in caring for younger children and other work. The ages of the children are more important than the size of the family in determining the women's time allocation patterns. Mothers' time allocation to home production activities was substantially increased when infants and pre-schoolers were present as they needed more parental attention than older children (King and Evenson 1983).

The children's and mothers' labour are to some extent substitutes in production. Thus, an increase in the distance from the home to school means less school enrolment of children and thus more children's work in home production, releasing women's labour to engage in wage employment. Substitutability between women's and children's labour tends to be more pronounced in less privileged households. Yotopoulos and Mergos (1986) showed that there is a substantial input of women's and children's time into 'men's activities' compared with the relatively small contribution by men to home production.

Khandker's (1988) study of women in households in Bangladesh suggested that women's labour force participation decisions are endogenous to household decision making. Women who participated in wage employment were younger, lived closer to a major market centre and had more schooling than women who did not participate in wage employment. Other factors that influenced their participation in the labour force were women's wage rate, husbands' education and the distance to school. A one per cent increase in women's wage was shown to increase women's time allocation to wage employment by 13 per cent (Khandker 1988: 121). Women's participation in the labour force was positively related to their spouses' education, contradicting Gronau's (1980) finding that an increase in husbands' education decreases women's labour force participation. On the other hand, women's education was not an important determinant of their time allocation (Khandker: 123). Variables such as the husbands' wage, the husband's premarital assets and household distance to market centres all decreased the probability of a woman participating in the labour force. Husbands' endowments of assets (excluding human capital) increased the wives' consumption of leisure and decreased their time allocation to both home and market production.

Khandker's study contradicted a finding by Cain, Khanam and Nahar (1979) that female labour–force participation in Bangladesh is restricted by social norms of female seclusion. While culturally determined division

of labour by age and sex is important in time allocation, Khandker noted that economic incentives play a major part. This appears to be a general trend among other developing countries (Mueller 1984).

This review of time allocation studies in various countries reveals some conflicting results. These conflicts are perhaps due to variations in the importance of social and economic factors and cultural norms in determining household behaviour.

Model specification and data

The time allocation model for Solomon Islands formulated in this study is based on the theory and literature review above, and reflects the fact that women's time allocation is influenced by many factors. A general description follows of the model used in the study, and the rationale is presented for use of the reduced-form ordinary least squares (OLS) analytical technique. A brief description of the data used is then given, followed by the definition and measurement of the pertinent endogenous and exogenous variables.

Model

The econometric model specified for use in this study consists of five equations describing labour allocation by women to five different activities: food gardening (*FG*), cash cropping (*CC*), work based at home (*WH*), other outside work (*OW*) and leisure (*L*). As the data on labour allocated to these activities are expressed in percentage terms, an identity is given which ensures that the percentage of time allocated to these activities adds up to 100 in the complete model. Thus, the general model may be written as:

$$FG = f(CC, WH, OW, L, X, u_1), \quad (1)$$

$$CC = g(FG, WH, OW, L, X, u_2), \quad (2)$$

$$WH = h(FG, CC, OW, L, X, u_3), \quad (3)$$

$$L = q(FG, CC, OW, WH, X, u_4), \quad (4)$$

$$OW = r(FG, CC, WH, L, X, u_5) \quad (5)$$

$$FG + CC + WH + L + OW = 100 \quad (6)$$

where f, g, h, q and r denote the appropriate functional relationships, X is a vector of exogenous variables and u_1, u_2, u_3, u_4 and u_5 are random error terms.

As it is reasonable to assume that decisions to allocate labour among the five activities would be made simultaneously, the set of equations consists of five endogenous variables and a set of exogenous variables. The identity represented by equation (6) implies that one of the equations is redundant because the value of one of the endogenous variables can be obtained by using the identity if the values of other four endogenous variables are known. Accordingly, it was decided to drop equation (5) from the system of equations and estimate the set of four simultaneous equations (1) to (4).

Econometric issues

A range of methods could be used to estimate the parameters of the system of simultaneous equations specified above. If the system of equations is linear in parameters, then two stage (2SLS) or three stage least squares (3SLS) could be applied to estimate structural parameters provided that the system is not under-identified. Alternatively, the parameters of the reduced form could be estimated by independently applying OLS to each equation of the system.

As the purpose of the study is to estimate the total impact of increased cash crop production on labour allocation to various activities, reduced-form parameters are the most appropriate. Accordingly, the following four reduced-form equations were derived by eliminating all endogenous variables from the set of equations (1) to (4):

$$FG = a_{10} + a_1 X \quad (7)$$

$$CC = a_{20} + a_2 X \quad (8)$$

$$WH = a_{30} + a_3 X \quad (9)$$

$$L = a_{40} + a_4 X \quad (10)$$

where a_1, a_2, a_3 and a_4 are coefficient vectors and OW is found from the identity

$$OW = 100 - (FG + CC + WH + L). \quad (11)$$

The reduced-form parameters for equations (7) to (10) were estimated by applying OLS to each of the equations.

Data source

Data collected in 1985-1986 for SP2 were used for this study. Three main categories of data were recorded at the household level. The resource base data contain general information on households' access to

resources, fulfilment of their 'basic needs' and cropping pattern. Income and expenditure data contain information on household income and expenditure on various consumption and investment activities. Time allocation data contain information on time allocated to various activities carried out by the adult members of the household.

Random sampling was used to select 99 surveyed households from which the data were collected. For this study, data for only 77 households were used as some variables necessary for the analysis were missing for 22 households. The sampled households used for the study are from five villages: Haimarao (20); Manakwai (19); Sumate (19); Tamboko (14); and Gwai'au (5).

Definitions and measurement of variables

The endogenous variables specified in equations (7) to (10) are time allocated by women to food gardening, work based at home, cash cropping and leisure. As there may be more than one female member in the household, it was decided to use the labour allocated by the female head of the household. The definition and measurement of variables are reported by Hardaker and Verspay (1988). A brief description from that report follows, with the five endogenous variables described first.

Time allocated to food garden (FG). *FG* is defined as the percentage of total time allocated by the female head of the household to all activities associated with food gardening such as preparation of a garden, planting, weeding, harvesting, selling and travelling to food gardens.

Time allocated to cash cropping (CC). *CC* is defined as the percentage of total time allocated by the female head of the household to all activities associated with copra and cocoa production such as planting trees, weeding and pruning, drying, carrying and selling.

Time allocated to work based at home (WH). *WH* is defined as the percentage of time allocated by the female head of the household to cooking and food preparation, household chores, household repair and construction, handicraft and child-rearing.

Time allocated to leisure (L). *L* is defined as the percentage of time allocated by the female head of the household to sleeping, eating, washing, socialising, special events and feasts, meeting and church services and for trips outside the village not connected with work or selling output.

Time allocated to outside work (OW). *OW* is defined as the percentage of total time allocated by the female head of the household to paid or unpaid work outside the farm-household.

The possible exogenous variables, and their expected effects on time allocation, are now reviewed.

Wage rate (WR). The relative wage rate of husband and wife was expected to be a major factor influencing the wife's time allocation pattern in the household. This is supported by time allocation theory and empirical analysis discussed above. *WR*, however, was not included as an explanatory variable in this analysis as time-series data are required to observe changes in women's time allocation patterns due to changes in wage rate. The data base used for this study was cross-sectional and hence any variation in women's time allocation due to changes in wage rate cannot be captured.

Cash crop production (CCP). Cash crop sales were used to measure cash crop production. This variable comprises the total of copra and cocoa sales. The data are expressed in Solomon Islands dollars (SI$).

As *CCP* competes with other activities for labour, the sign of the parameter associated with this variable was expected to be negative for food gardening, work based at home and leisure. The effect on time allocated to cash cropping was expected to be positive.

Women's age (WA). *WA* is defined as the age of the female head of the household. The age of women can be an important factor in determining how their time is allocated between competing activities. Warmke (1985) found that women 35 years and older worked longer hours and had bigger food gardens. These were also the only women occasionally having surplus potatoes to sell at the local market. Jones, Fleming and Hardaker (1988) also reported that women's age was a major factor influencing a household's consumption of staple root crops. Women's age also had a positive effect on the surplus of garden crop for sale (Fleming 1989). Accordingly, the female household head's time allocation to the food garden was expected to be positively correlated with her age.

Women's age was not expected to be important in explaining their time allocation to cash cropping. Time allocated to work based at home was expected to decrease with age as older children help more with household chores and, hence, time committed to these activities is reduced. For similar reasons, women's leisure time was expected to increase as they get older.

Number of children (NCH). *NCH* is defined as the number of male and female children up to the age of 15. Children affect women's time allocation more substantially than men's. The presence of infants often erodes women's limited amount of leisure, reducing sleep time to a biological minimum (King and Evenson 1983). On the other hand, older children contribute to the household economy. For example, older daughters look after the siblings and older sons help with the food gardening. Thus, it is not easy to predict the effect of children on women's time allocation. However, the presence of children in a household is likely to increase the workload for women in the home and decrease their time in food gardening, cash cropping and leisure.

Household size (HS). *HS* is defined as the total number of individuals in the household. Consumption and production units as defined by Hardaker and Verspay (1988) were alternative measures of household size used in this study.

The size of the household may have positive or negative effects on women's workload. The bigger household represents increased labour units and, hence, increased hours to be allocated to household activities. On the other hand, it also represents increased consumption units; hence, more members need to be cared for, increasing the workload.

Household expenses (HE). *HE* is defined as annual household expenses. This expenditure consists mainly of purchases of food and is recorded in SI$.

Increased monetisation in the household economy has substantially reduced the diet based on food garden production. Imported food, chiefly rice, constitutes a significant proportion of the daily diet. This is reflected in the increase in food imports from SI$2.1 million to SI$45.8 million between 1970 and 1992 (NCDS 1995). Among low-income households, most household expenses consist of food purchases. As the imported food reduces the reliance on food gardens and is not as labour-intensive to prepare, female household heads' time allocated to these activities was expected to decrease with an increase in household expenses. This was expected to increase their time allocated to cash cropping and leisure.

Non-labour income (NI). *NI* includes remittances from family members who have migrated to Honiara or overseas, resource transfers between the relatives, pensions and other receipts, recorded in SI$.

According to the theoretical exposition given above, an increase in non-labour income does not affect time allocated to farm work and work based at home. However, leisure was expected to increase with an increase in non-labour income.

Household assets (HA). These assets are defined as the total value of assets (in SI$) owned by the household. They include farm implements (such as copra and cocoa driers, sprayers, bush knives and cattle fences), home implements (such as stoves, kerosene lights, sewing machines, bicycles and radio cassettes) and fishing implements (such as various kinds of canoes and fishing nets).

Kunert (1986) and Fleming (1989) did not find household assets to be a significant factor in determining the level of food garden output for sale in Solomon Islands. In Khandker's (1988) analysis of Bangladeshi households, on the other hand, household assets were negatively correlated to women's time allocation to work based at home and positively correlated to leisure time. Similar results were expected for the study villages for the following reasons. Most household assets constituted fishing and farm implements associated with commercial production. Hence, the time allocated by the female household head to cash cropping was expected to be positively correlated to household assets. To the extent that affluence is reflected by asset values, women's time allocated to food gardens should decline with an increase in the value of assets.

Time allocated by other female members of the household to food gardening (OFG). This variable is defined as the average percentage time allocated to food gardening by other female members older than 15 years.

Women tend to engage in joint production. The presence of a second female in the household can dramatically influence the time allocation of the principal woman of the household. The supporting females may be elder daughters or other family members. With the presence of the other female in the household, the proportion of female household head's time allocated to food gardening was expected to decrease if other female members assist the household head in food gardening.

Other variables. Other variables of possible relevance tested in the model are the number of cash crop plants, area of food garden, presence of hired labour, number of males in the household between the ages of 15 to 54 and 55 years and older, household consumption and labour units, number of male and female children in the household and village dummies.

The expected signs of the parameters associated with the included exogenous variables are summarised in Table 5.1. A question mark denotes that no firm expectations are held about the effects on endogenous variables *a priori*.

Results

As background to the regression estimates, the average labour usage on food gardens, cash cropping, work based at home, other outside work and leisure is 16.9 per cent, 3.6 per cent, 19.6 per cent, 4.2 per cent and 55.7 per cent, respectively. The data indicate that women spend a majority of their time on leisure, but this does not mean that women have plenty of spare time. The leisure time in the data set also include time allocated to essential activities such as social events, sleeping and eating. Due to the nature of the data set used, it was not possible to obtain information on time allocated to pure leisure. Other activities which take up most of women's time are work activities based at home and food gardening. Women seem to spend the least amount of their time on cash cropping.

Linear and log-linear specifications of equations (7) to (10) were tested, and the linear model consistently performed better statistically. Hence, it was adopted as most suitable for the analysis. Dummy variables for villages were used for both the intercept and slope coefficients. Although their coefficients were statistically significant at the 5 per cent level they were dropped from the final equations as no obvious socio-economic interpretations, other than that the villages have different characteristics, could be attached to them. Coefficients associated with most parameters were small and statistically insignificant when the dummy variables were used.

Of the eight exogenous variables specified, women's age and non-labour income were statistically insignificant in all four equations. Accordingly, they were dropped and the reduced form equations were re-estimated. The results of the re-estimated equations are presented in Table 5.2. The adjusted R^2 values for all equations, although generally low by conventional standards, are acceptable for estimations based on cross-sectional data.

Explanations of the effects of the exogenous variables on the endogenous variables are as follows.

Cash crop production (CCP). The estimated coefficients associated with *CCP* are negative for equations (I) and (4) and positive for equations (2) and (3) in Table 5.2. The negative and statistically significant coefficient of *CCP* in equation (I) implies that, for a SI$1000 increase in cash crop production, the time allocated by the female head of the household to food gardening decreases by 4.1 percentage points. This result confirms the hypothesis that there is competition in labour use between cash cropping and food gardening in the study villages.

The coefficient of *CCP* in equation (2), relating to labour allocated to cash cropping, is positive and statistically significant. This indicates that the time allocated by the female head of the household to cash crop production increases as cash crop production increases. The effect of an increase in cash crop production by SI$1000 is to increase labour allocated to cash crop production by 6.1 percentage points. The net effect between results from equations (1) and (2) is thus to increase labour allocated to farm activities by 2 percentage points. It indicates that women spend more time on farm activities as cash crop production increases.

The coefficient of *CCP* in equation (3), relating to work at home, is positive but statistically insignificant, indicating that the level of cash crop production is not an important variable in explaining women's time allocated to work based at home. That in equation (4), relating to leisure, is negative, as expected, and statistically significant. This implies that an increase in cash crop production is likely to be achieved at the cost of women's leisure.

Number of children (NCH). The coefficient associated with *NCH* is negative and statistically significant in equations (I) and (3) but statistically insignificant in equations (2) and (4). The estimates indicate that the time allocated to the food garden by the female head of the household decreases with an increase in the number of children. An increase in the number of children, on the other hand, increases her time allocation to work based at home. Thus, with an increase in the number of children, women seem to have substituted work based at home for work on food gardens. The effect of children in the household is confirmed as being home-time intensive as depicted in theory and supported by most empirical studies.

Household size (HS). The coefficient on *HS* is statistically significant for equations (I) and (3) and statistically insignificant for equations (2) and (4). The positive coefficient in equation (I) implies that the time allocated to food garden increases by three percentage points with an addition of one member to the household. Thus, it appears that the positive effect of

Table 5.1 The expected effects of exogenous variables on endogenous variables in the Solomon Islands

Exogenous variable	Time allocated by the female head of household to			
	Food gardens	Cash cropping	Work at home	Leisure
Cash cropping	-	+	-	-
No. of children	-	-	+	-
Household size	?	?	?	?
Household expenses	-	+	-	+
Household assets [a]	-	+	-	+
Other females [a]	-	?	?	+
Women's age	+	?	-	+
Non-labour income	?	?	?	+

[a] Time allocated by other female members of the household to food gardening.

Table 5.2 Estimates of the reduced form parameters for Solomon Islands

Exogenous variables	Time allocated by the female head of household to			
	Food gardens (Equation 1)	Cash cropping (Equation 2)	Work at home (Equation 3)	Leisure (Equation 4)
Cash cropping[a]	-4.10*	6.10*	2.06	-3.22*
	(-2.52)	(6.38)	(1.05)	(-1.68)
Number of children	-3.02*	-0.01	3.69*	-1.10
	(-2.71)	(-0.01)	(2.72)	(-0.84)
Household size	3.38*	-0.04	-3.00*	-0.26
	(3.19)	(-0.06)	(-2.33)	(-0.21)
Household expenses[a]	-6.11*	-4.50*	-0.90	7.32*
	(-2.99)	(-3.76)	(-0.36)	(3.03)
Household assets[a]	-3.48	4.05*	4.78	-5.66
	(-1.32)	(2.61)	(1.48)	(-1.81)
Other females[b]	-0.36*	0.09	0.23	-0.07
	(-2.11)	(0.98)	(1.12)	(-0.33)
Intercept	12.81*	0.69	23.05*	62.21*
	(4.36)	(0.40)	(6.43)	(17.86)
Adjusted R^2	0.31	0.38	0.05	0.17

[a] Variables are scaled to SI$1000 for estimation purposes.
[b] Time allocated to food gardening by other female members of the household.

increased consumption on women's time allocated to food garden has dominated the negative effect of increased labour availability as the household size increases (see above). This is in line with the finding that household size is a major factor determining the food garden area (Fleming 1989).

In the case of women's work based at home, the sign of the coefficient is negative. This indicates that the negative effect of additional labour on time allocated by the female head of the household to work based at home dominates the positive effect of increased total work load as the household size increases.

Household expenses (HE). Household expenditure is an important variable altering the time allocation pattern of the female head of the household. The coefficients associated with *HE* are statistically significant in equations (1), (2) and (4), but statistically insignificant in equation (3). The coefficient in equation (I) implies that an increase of SI$1000 in household expenses reduces time women allocate to food gardens by six per cent. It is worth recalling that household expenses consist mainly of expenditure on purchased food such as rice, bread and canned products. As purchased food and garden produce are substitutes, the demand for garden produce and hence labour allocation to food gardens are reduced with an increase in the consumption of purchased food.

As expected, there is a positive relationship between household expenses and women's leisure time. This result is explained by the fact that the level of household expenses are highly correlated to household income; theory and empirical evidence both suggest a positive association between leisure and income level.

Household assets (HA). The coefficient on the variable *HA* is statistically significant in equation (2). With an increase in household asset value of SI$1000, women's time allocation to cash cropping is estimated to increase by four percentage points. Household assets consist mainly of tools and implements useful in cash crop production. The positive effect is therefore probably due to the complementarity between such tools and implements and labour in cash cropping.

Time allocated by other female members of the household to food gardening (OFG). The coefficient *OFG* relates to the average percentage of time spent in food gardening by other females in the household. Its coefficient is statistically significant in equation (I) only. The negative sign implies that, as expected for food gardening, other women's labour is a substitute for the labour of the female head of the household. A one per

cent increase in time allocated to food gardens by other females in the household reduces the time allocated by the female household head by 0.36 per cent.

Interpretation of results and implications

The government of Solomon Islands has encouraged cash crop production as a means of increasing agricultural output and raising rural incomes. As a result, copra production almost doubled and cocoa production increased ten-fold between 1970 and 1984 (NCDS 1995). The variety and volume of output of food gardens have decreased due to the substitution of cash cropping for food gardening. Nevertheless, food gardening is still an important activity among smallholders.

Due to the higher profitability of cash crops, some of the best agricultural land previously used for food gardening is now being used for cash cropping. As a consequence, food gardens are being pushed to marginal land and on locations further away from the settlements. In villages with more intensive cash crop production, it is not uncommon for food gardens to be located as much as three to four hours walking distance. Hence, more effort is required to manage them. As food gardening is predominantly women's responsibility, such changes in land use patterns have altered the way women use their time in the rural economy.

Traditionally, men also contributed to production in the food garden. With the switch to cash crop production, however, men have withdrawn their labour from food gardening for use in cash crop production, leaving women with the responsibility of producing and marketing the output from food gardens. In addition, women also undertake about one-third of activities associated with copra production and nearly half in cocoa production.

Overall, the results support prior expectations about the effects of exogenous variables on the endogenous variables in the estimated model. There is a high degree of competition between the activities of the female head of the household. The results confirm that cash crop production, number of children in the household, household size and household expenses are important variables in explaining her time allocation patterns.

The government strategy of promoting cash crop production to enhance economic growth in Solomon Islands may help achieve some national objectives, but the results presented in this study suggest that the transition to cash cropping can lead to an increase in the work load for women and a reduction in the food garden output due to transfer of labour away from

leisure and food garden production. The government does not seem to have considered such secondary effects in its formulation of development strategies and policies. Consequently, the welfare of the household (and especially that of women) is likely to be adversely affected. As cash cropping is mainly controlled by men, expansion of cash cropping could lead to a decline in women's income-earning capacity, a decline in their control over household resources and, ultimately, a decline in their social status. Growth strategies based on a transition to cash cropping usually lead to the industrialised nation's pattern of male domination in the workforce (Boserup 1970; Rogers 1979; ISIS 1983; Charlton 1984; Kandiyoti 1988; Momsen 1991). For example, in Guadalcanal, where traditional land heritage is by matrilineal descent, cash cropping appears to have undermined the authority of women over land use decisions as men take increasing control.

The results obtained in the present study suggest that the time allocated to work based at home is unlikely to decrease as more labour is used for cash crop production. Women's time allocation to work based at home is firmly determined by the social norm that work at home is the responsibility of women. The government may need to foster ways to reduce women's work based at home because such workload is unlikely to be reduced as rural incomes increase and they spend more time on farm and non-farm activities. In particular, technologies which improve the efficiency of women's labour should be helpful. Technological options, such as improved stoves which reduce cooking time and make more effective use of fuelwood and improved techniques of growing and processing food crops, can release substantial amounts of women's time.

Food self-sufficiency at the national and the household levels is one of the declared objectives of the government of Solomon Islands (Government of Solomon Islands 1985). The results of this study indicate that production from food gardens is likely to decline with an expansion of cash crop production as food gardens are pushed onto marginal land and as women's labour is withdrawn from food gardening. Also, the scope for food gardening as a food security cushion to the adverse effects of poor export earnings is likely to diminish. Thus, parallel efforts to maintain or increase the food garden output through policies such as improved infrastructure and marketing facilities may be helpful in improving food security.

Development strategies and policies—and their implementation through programs and projects—to provide more income to women are generally advocated as a way to improve women's welfare in developing countries. While they can have benefits, the high degree of competition for women's time between various activities needs to be taken into account if such policies are to be introduced and implemented successfully. Additional work required for participation in income generation programs and projects may be drawn from the leisure time of already over-worked women if they are poorly designed.

The impact of commodity exports on economic growth in Fiji, Papua New Guinea and Solomon Islands

Sospeter Onchoke

A controversy surrounds the influence of the expansion of export revenue on economic growth in three Melanesian countries: Fiji, Papua New Guinea and Solomon Islands. This issue is of importance to strategic national planning in Melanesia.

The focus of this study is on both the short and long-term relations between exports and gross domestic product (GDP), changes in the latter being used as a proxy for economic growth. Using data from three Melanesian countries investigations are accomplished by applying cointegration analysis for long-run relationships and Granger causality tests, forecast error decomposition analysis (FEDA) and impulse response analysis (IRA)—all based on autoregressive (VAR) models—for short-run anaiysis.

Primary export development in Melanesia

The initial export commodities of Melanesian countries were copra and coconut oil, followed by other plantation crops such as cocoa, sugar, coffee and oil palm. Despite participation of village-based small-scale producers in copra export production throughout Melanesia in the late 19th century and early 20th century, it was not until after political independence that smallholders truly became an integral part of the agricultural export sub-sector. Independence brought profound changes in economic activities, characterised by an increasing dependence on foreign exchange earnings to generate economic growth. From the late

1950s—and especially following independence—small-scale farmers thrived to the extent that they overtook the plantation sector in the production of most agricultural export commodities.

Figure 6.1 presents exports as a proportion of GDP for the past three decades (in 10-year averages). The relative size of export markets in Melanesian economies is quite large, reflecting their openness, but not overwhelmingly so. In no period was the proportion of exports to GDP greater than 45 per cent in any country. Figures could not be estimated for the first two decades in Vanuatu, but the proportion of commodity exports to GDP in the 1980s was only 17 per cent. Commodity exports contributed an increasing share of GDP in Papua New Guinea and Solomon Islands during the post-independence period but the share in Fiji declined from 33 per cent in the 1960s to 26 per cent in the 1970s, at which it stabilised in the 1980s. Increases in shares in Papua New Guinea and Solomon Islands were caused by rapid expansions in mineral exports and timber and fish exports, respectively.

Yet commodity export revenues in all countries have been losing ground to non-commodity inflows as sources of foreign exchange earnings. The dominance of non-commodity revenue in total foreign inflows[1] over the period 1985 to 1992 is shown in Figure 6.2. Only in Papua New Guinea do commodity exports still clearly outweigh other sources of foreign exchange. In Vanuatu their share is only around one-tenth that of other inflows—predominantly financial service, tourism and aid receipts. The contribution of agricultural exports is even less, varying from 22 per cent of total inflows in Fiji to eight per cent in Vanuatu. These period averages hide the declining contribution of agriculture in recent years. Between the mid-1980s and the early 1990s, the share of agriculture more than halved in Papua New Guinea, approximately halved in Solomon Islands and Vanuatu, and declined by around one-third in Fiji.

Over the past three decades, then, the primary role of agriculture as a source of foreign exchange earnings has clearly been challenged, and its share of foreign exchange earnings is now small in all countries. This challenge has arisen from two main sources

- diversification into other primary industries, such as forestry, fisheries and (especially in Papua New Guinea) minerals, has reduced the relative importance of agriculture in the commodity export sector

Figure 6.1 Exports as a proportion of GDP in Melanesian countries, 1960 to 1990

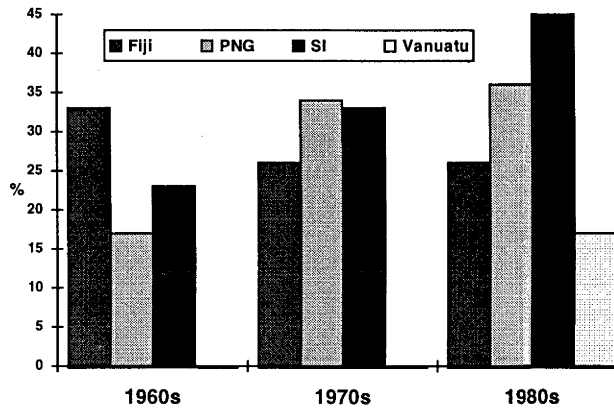
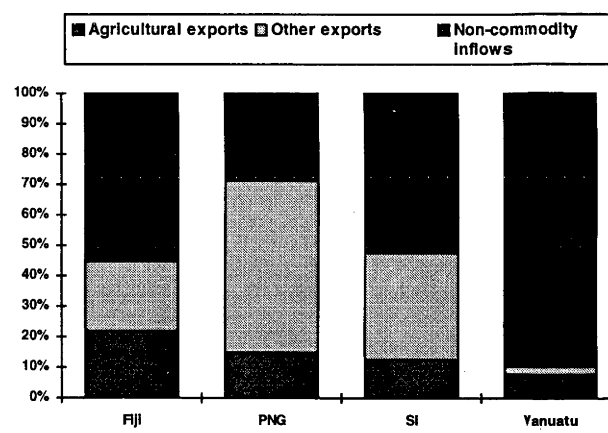


Figure 6.2 Composition of foreign inflows in Melanesian countries, 1985 to 1992



- non-commodity foreign inflows, such as spending by tourists, remittances from expatriate populations, foreign investment, financial services (in the case of Vanuatu) and aid funds, which dwarf inflows from commodity exports in many South Pacific countries and are now considerable in all Melanesian countries.

Role of exports in economic growth

Views about the role of exports in generating economic growth can be traced back to the early days of classical economics when foreign trade was regarded as a crucial stimulus to economic growth. Its importance was attributed in part to its role in providing a destination for surpluses that could not be cleared due to small domestic demand. In return, other goods useful to the domestic economy could be imported from external sources. By opening up to external markets, domestic productive resources could be put to optimal use, with increased division of labour, to expand national output and increase the wealth of a nation. Foreign trade would also stimulate inventions and improved production processes, encourage new ideas, increase ambitions, introduce new tastes and offer expanded opportunities for economic activity, inducing people to save and accumulate capital for yet more satisfaction in future periods.

Following the principle of comparative advantage, commodity exports expanded in developing countries in line with relative factor endowments and movements. In their search for new sources of raw materials and cheap and abundant labour, and new markets for manufactures, the colonial powers exploited the relatively cheap resources found in their colonies. This led to the establishment of export enterprises that were intensive users of natural resources and unskilled labour, explaining the establishment of numerous plantations for export. Such plantations thrived for a long period and still exist in most developing countries today, although their ownership might have changed with the advent of independence. They required large amounts of capital (to exploit economies of size) and small numbers of technical and managerial resources, mainly imported, to complement the abundant labour and natural resources in the production processes.

There is a strong economic dependence on exports of primary commodities in most developing countries. Adams and Behrman (1982) estimated that exports of primary commodities account for up to 80 per cent of total export earnings in developing countries, while most rely on

imports for processed commodities and capital goods. This trade pattern implies that improvement of export performance is crucial to sustainable economic development, unless acccess to foreign inflows can be sustained from sources other than commodity exports.

Early empirical work on export-GDP relationships used simple methods such as Spearman's rank correlation and ordinary least squares regression analysis (Emery 1967; Michaely 1977; Feder 1983). These studies provided some evidence of a positive association between exports and GDP and were taken at the time to imply causal relationship. But they did not show the direction of the relationship, which motivated others to explore this relationship using more sophisticated methods that could test for causality. Studies in which various causality tests have been applied include, Jung and Marshall (1985) for 37 developing countries, Ahmad and Kwan (1991) for 47 African countries, Serletis (1992) for Canada and Giles, Giles and McCann (1992) for New Zealand. All used Granger causality tests (Granger 1969). Studies employing both Granger causality tests and Sims causality tests (Sims 1972) include Hsiao (1987), for four newly industrialising countries in Asia, and Love (1992), for 20 trade-dependent countries. Sims causality tests were used by Chow (1987) for eight newly industrialising countries.

The empirical results from most of these studies remain controversial, contradictory and mixed (Ahmad and Kwan 1991), and largely inconclusive. Their interpretation is difficult because it is not certain whether lack of evidence of causality, when found, is due to shortcomings in technique or data, or because there is a lack of real relationship.

Theoretical underpinning

This study differs from previous studies of causality between exports and economic growth by employing Granger causality tests that embody recent developments including unit root tests, cointegration analysis, FEDA and IRA integrated in one package. Testing procedures based on the works of Phillips (1987), Phillips and Perron (1988), Park and Choi (1988) and Park, Ouliaris and Choi (1988) are introduced to test for directions of causality between exports and economic growth. The study also employs two empirical tests proposed by Akaike (1974) and Schwarz (1978) to find optimal lag lengths for the data series under investigation.

The hypothesis to be tested—that export growth causes economic growth—appears trivial on the surface. GDP is the sum of consumption, investment, government expenditure and net exports (exports minus imports) and thus it can be postulated that a rise in exports will always increase GDP. In theory, export growth contributes to domestic capital formation and generates investment demand in both export and related industries. Through importation, export trade is usually accompanied by the introduction of new technologies from foreign markets, and more advanced technology should ultimately raise labour productivity and generate higher returns to capital.

The open nature of Melanesian economies and their heavy dependence on imports of processed products and capital goods and high import propensity (Skully 1985), combined with their small domestic markets, indicate that they are prime candidates for reliance on exports for economic growth. There is no guarantee, though, that imports will be used for productive purposes and much has been made by observers (Browne and Scott 1989) of the tendency for Melanesian countries to import luxury and other non-productive consumption goods. Thus, a substantial proportion of imports might not contribute directly to capital formation and enhanced productive capacity in Melanesian countries. Nor is it inevitable that other favourable 'knock-on' effects will eventuate. Two other common arguments are often put forward as to why export orientation will reduce economic growth. First, export instability could have a negative impact on economic growth, especially in Melanesian countries with small foreign reserves and underdeveloped financial markets—although the evidence to support this proposition is not convincing (Onchoke and Fleming 1994). Second, secular declines in the terms of trade in the industries producing commodities typically exported by countries, such as those in Melanesia, reduces the value of their exports over time—again, a proposition with mixed support. In practice, an increase in exports could occur at the expense of equally valuable production for the domestic market (and consumption) with none of the compensating advantages mentioned above, which means that increased exports might not lead to a higher GDP and could conceivably lower it. So an empirical question to be tested is whether or not exports increase GDP.

Different exports produce different stimuli. Beyond primary increases in export output using different input-output coefficients, some commodities require value-adding through processing and marketing activities prior to export. The extent of value-adding is largely dictated by

the learning process of economies. In particular, the processing of primary export commodities using modern techniques should benefit other activities across the economy by spreading technical knowledge, training labour, the demonstration effect of new methods, allocational gains, increased capital formation, higher factor productivity, foreign exchange earnings, and acquisition of management and supervisory skills (Thoburn 1977; Kavoussi 1984). Learning processes are facilitated—and differentiated between countries—by the generation of new skills, technical change and innovation in export and related industries.

According to Thoburn (1977), more favourable linkages are likely to stem from exports that require skilled rather than unskilled labour. Processing of primary commodities that provides forward linkages is also important in stimulating economic activity, as are backward linkages to industries supplying inputs to export firms that generate derived demand by export industries for goods and services.

Analytical framework

The tests used in this study are unit roots tests, cointegration tests, causality tests, FEDA and IRA. These analytical procedures are now well-established and their properties, estimation methods and merits are well covered in the literature (see In, Onchoke and Fleming 1984)

Three methods of testing for unit roots were employed in this study, namely, the augmented Dickey-Fuller (ADF) test (Dickey and Fuller 1981), Phillips and Perron (PP) test (Phillips and Perron 1988), and Park and Choi (PC) test (Park and Choi 1988). These tests were employed to ascertain the statistical properties of GDP and export variables. If these statistics are unknown and data are not transformed according to their properties, the standard statistical tests on them are likely to be spurious (Granger and Newbold 1974).

Cointegration tests were originally formulated by Granger (1981) to establish the long-run equilibrium relationship between two or more variables. This is equivalent to finding out whether bivariate series are driven by common trends (Stock and Watson 1988). The export and GDP variables can be said to be cointegrated if their data series have a linear combination that is stationary even if their individual series are non-stationary or unit roots. Again, the ADF and PP tests were used to test for cointegration, along with a third test, the Park-Ouliaris-Choi (POC) test (Park, Ouliaris and Choi 1988).

Granger causality tests were used to predict whether export growth causes GDP growth in the short term (Granger 1969). For these tests, ordinary least squares regression is applied in a bivariate system of equations. If the two variables are cointegrated, the representation causality is generated by an error correction model (Granger 1988). A risk with using Granger causality is that a large number of observations is ideally needed to apply Granger causality tests. Empirical problems with short time series are not suited to asymptotic validity tests.

FEDA and IRA techniques are also used to analyse dynamic relationships between variables in a VAR model. Interactions among variables can be assessed by investigating the effects of error terms on the subsequent movements of all variables in the model. This is achieved by transforming the estimated VAR equations to derive a moving average representation of the VAR model and examine the dynamic relations between the variables. Being a decomposition procedure, FEDA is preferred to Granger causality tests when the number of observations are limited. It entails the apportionment of forecast variance errors that permits sources and their associated contributions to variation of a particular variable in a system (Ford 1986).

IRA is a shock evaluation procedure wherein the dynamic characteristics of a system are assessed. It reveals the effect on a system of a shock introduced through one variable in it. Coefficients provide impulse response functions that map out the responses of all variables in a model to an increase of one standard deviation in one of the variables (Ford 1986). For example, IRA could be used to predict what happens to GDP if there is an increase in export revenue. Orthogonalisation of variables using a Choleski decomposition procedure was performed to obtain more meaningful results from both FEDA and IRA using the RATS program (Doan 1990).

Data used were annual f.o.b. aggregate export values and GDP for a period of three decades, from 1960 to 1990 in Fiji, 1961 to 1991 in PNG and 1960 to 1990 in Solomon Islands. These data series were the longest that could be consistently obtained, and their brevity admittedly weakens the legitimacy of the results, but they are the best option available. It was not possible to obtain at least 30 years of consistent data for Vanuatu, which meant that empirical analysis was confined to three countries. Many sources of data were used, particularly NCDS (1992) and IMF (1992) but also various government and private reports. These sources include Fiji Government reports (1982, 1991), various editions of the *Pacific Islands*

Yearbook, colonial government reports (Anon. 1970), Australian government reports (Australian Government 1973), and reports from the Bank of Papua New Guinea (1991), AIDAB (1991a, 1991b), Lam (1984) and Central Bank of Solomon Islands (1992).

Results

Unit roots

Most results of unit roots tests show that exports and GDP are stationary in their first difference form. Most cointegration tests reveal that exports and GDP were not in long-run equilibrium; that is, they are not cointegrated. Based on these results, the variables in a VAR model are represented in first differences (Engle and Granger 1987, Granger 1988). Optimal lag lengths were tested for up to four lags using the Akaike information criterion (AIC) and Schwarz criterion (SC) tests (Schwarz 1978) using the RATS application package (Doan 1990). In most cases the optimal lag length was found to be one year although the AIC test suggested a two-year lag length in Papua New Guinea.

Cointegration

Because no cointegration was exhibited, Granger causality test results should be regarded as short-run dynamic relationships. The tests were done in logarithmic differences rather than absolute levels to avoid explosive results. Results failed to reject the hypothesis that there is no causality running from exports to GDP or from GDP to exports in Fiji and Solomon Islands. In Papua New Guinea, strong evidence of feedback—or bidirectional Granger causality—was found between exports and GDP for both one-year and two-year lags. On the basis of these results, there is only limited support for an export-oriented growth strategy.

Despite the open nature of Melanesian economies, these results are not surprising given the results of similar tests carried out elsewhere in developed and developing countries with quite open economies (for example, Jung and Marshall 1985; Chow 1987; Hsiao 1987; Ahmad and Kwan 1991; Giles et al. 1992). Nor are they surprising given the relatively small number of observations used in tests. Serletis (1992) did find that export growth caused growth in GDP in Canada using a very long time series, from 1887 to 1985.

FEDA

More useful information is gained from the results of FEDA reported in Table 6.1 for VAR in first differences. They depict a situation quite different from those reported above for the cointegration and causality tests. In Papua New Guinea, where bidirectional causality was found (but no cointegration), the forecast error variance in exports explained about 57 per cent of the forecast error variance in GDP. Therefore, the empirical evidence from both causality tests and FEDA supports the contention that growth in exports leads to increased GDP.

Table 6.1 Variance decomposition of GDP in Melanesian countries

Period	Exports	GDP
FIJI		
1	35.7	64.3
3	34.7	65.3
5	34.7	65.3
8	34.6	65.4
10	34.6	65.4
15	34.6	65.4
20	34.6	65.4
Average	35.0	65.0
PAPUA NEW GUINEA		
1	44.2	55.8
3	58.6	41.4
5	58.7	41.3
8	58.7	41.3
10	58.7	41.3
15	58.7	41.3
20	58.7	41.3
Average	57.0	43.0
SOLOMON ISLANDS		
1	59.6	40.4
3	57.7	42.3
5	57.7	42.3
8	57.7	42.3
10	57.7	42.3
15	57.7	42.3
20	57.7	42.3
Average	58.0	42.0

In Fiji where exports and GDP were not cointegrated and no causality was detected, it can now be seen that some contemporaneous relationship exists between the two variables. Almost two-thirds of the variation in GDP is attributed to the forecast error variance of GDP itself and just over one-third to export forecast error variance. The contribution by exports stabilised at around 35 per cent, implying that about 35 per cent of the forecast error variance of export growth is positively associated with the forecast error variance of growth in GDP.

The Solomon Islands case is also interesting because 57 per cent of variation in GDP is accounted for by export forecast error variance. This result is in contrast to the findings on cointegration and causality for this country. Across all countries, it can be seen that export forecast error variance contributes substantially to variation in GDP.

IRA

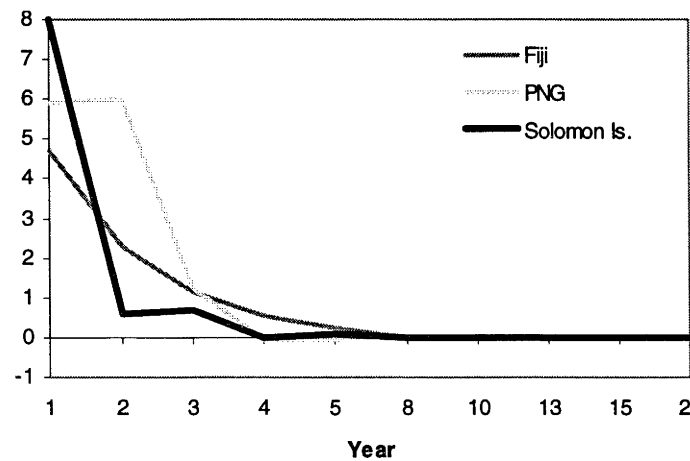
IRA results are presented in Figure 6.3. In Fiji, a one standard deviation shock in exports led to a positive response in GDP that peaked at 4.7 per cent in the first year. The responses then diminished progressively to approach zero by year 10 but were already trivial (less than one per cent) by year four. All responses were positive, which is the main difference between the results for Fiji and those for the other two countries. In the latter cases positive initial responses were followed by both positive and negative responses in later years.

Positive responses of GDP to exports in early years in Papua New Guinea were followed by a period of negative export response which evoked a negative response in GDP in years four to six. The impact of export shocks on GDP was greatest in this country at six per cent for the first two years, consistent with the FEDA results, but were trivial after year three.

In Solomon Islands, a high initial response of over eight per cent occurred in year one. The impact quickly dissipated to below one per cent in years two and three, and then trivial amounts in succeeding years.

It is evident from the IRA results that shocks in exports in Melanesian countries almost always triggered a response in GDP in the same direction, both immediately and with lags. Even where negative responses were recorded, they were in every case negligible amounts.

Figure 6.3 IRA results for Fiji, Papua New Guinea and Solomon Islands



Strategic implications

The goal of the study was to test for long-run and short-run relationships between exports and GDP in Melanesian countries. Long-run relationships were analysed using cointegration tests while short-run relationships were analysed using Granger causality tests, FEDA and IRA, all based on VAR models. With few exceptions, cointegration tests of the hypothesis of long-run relationships between exports and GDP rejected the hypothesis. Tests of a short-term relationship unambiguously indicate bidirectional causality in Papua New Guinea. But the situation in Fiji and Solomon Islands is less clear because of the difficulty created by use of a much smaller number of observations than is desirable. In this respect, it is prudent to place more emphasis on the results from the application of FEDA because it is a procedure of decomposition that is less dependent on a long data series. Following this approach, one can conclude that short-run relationships exist although the impact of exports on GDP largely fades away after a few years according the IRA results.

The lack of evidence of long-run relationships in Fiji, Papua New Guinea and Solomon Islands can be attributed to two possible explanations. Either difficulties in detecting such relationships were caused by the short data series, or the unsustainability of short-run impact by exports on GDP means that it is not possible to maintain a long-run relationship.

Further study is needed to confirm why the results obtained for Fiji and Solomon Islands do not conform unambiguously to the theory of export-driven economic growth and why long-run equilibrium between exports and GDP were not established in any of the three countries. A precondition for any further study is the use of a longer data series. In the meantime, strategic implications can be discussed keeping in mind this limitation of the empirical analysis.

Four strategic implications are drawn from the analysis.

- The notion that exports are actually bad for economic growth in Melanesia can be quickly dismissed: evidence suggests a positive or negligible relationship.
- The most appropriate path for economic growth would most likely be one determined by an export-led strategy, but only with the following proviso. While exports seem to generate economic growth, the way in which they do so is not as straightforward as some proponents of export-led growth make out. It appears that the economic benefits of exports can be quickly dissipated unless other factors in the economy are favourable to growth. In particular, as Kavoussi (1984: 249) concluded, 'if primary exports contribute to economic growth in more advanced developing countries, they do so mainly through the acceleration of the rate of capital formation'.
- Underdeveloped financial markets and low rates of saving from export revenue are probably the main factors limiting the impact of export growth on GDP in Melanesia.
- The rapidly declining importance of commodity exports as a source of foreign exchange earnings might partly explain the lack of unequivocal results on the impact of commodity exports on economic growth in Fiji and Solomon Islands but a clear relationship in Papua New Guinea. Whereas commodity exports still contribute a high share of foreign inflows in Papua New Guinea, they have become a minor source in the other two countries.

Sources of income inequality in rural villages in Solomon Islands

Frank Maeaba

Like other South Pacific countries, Solomon Islands is often thought of as an egalitarian society but with this equality is threatened by the pursuit of economic growth which creates divergences in income among the population. With a high proportion of the population living in rural areas, agricultural growth might lead to increasingly unequal distribution of income, particularly in rural areas. Such a proposition is investigated in this study by measuring inequality of income distribution in rural villages in Solomon Islands, and decomposing the inequality into its sources.

One of the development goals of the Solomon Islands government has been 'to foster a more just society through redistributing national income and wealth' (Solomon Islands Government 1985: 14). This value judgment about equity made by the government implies that it possesses quite a strong degree of aversion to inequality, and would be prepared to take steps to ensure a high degree of equality. This stance becomes an important issue when interpreting estimates of income inequality.

Decomposing such estimates makes it possible to determine which income sources contribute most to inequality. The distributional effect of a marginal change in each income source is measured to ascertain which income sources contribute to a lessening of income inequality and which increase it.

The aim of this inquiry is to determine the sources and extent of inequality of income distribution in rural villages in Solomon Islands. The villages used are those studied by Jones et al. (1988). They were chosen as a cross-section of villages at different stages of commercialisation, thereby allowing some generalisations to be made about the extent to which commercialisation, particularly through cash cropping, is accompanied by worsening income distribution.

Background

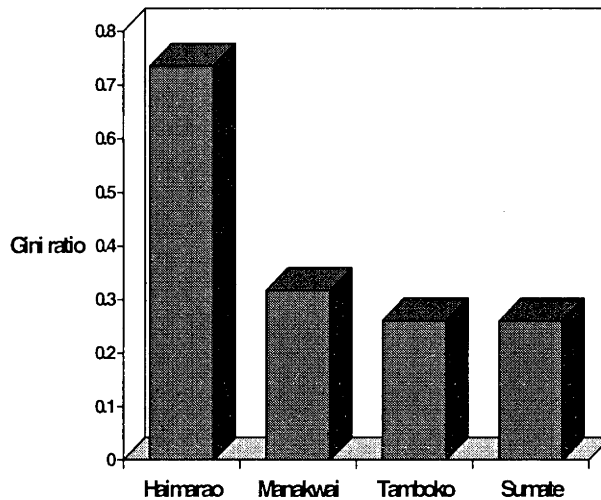
The Solomon Islands economy is predominantly rural, and agriculture still accounts for a high proportion of GDP—around one-half for the three-year period 1985-87 (NCDS 1995). Smallholder agriculture, which is chiefly subsistence-oriented, is the main system of agricultural production and the majority of rural households depend on agriculture as their main source of cash income and for their livelihood. Despite this reliance on agriculture, most rural households also obtain some income from non-farm sources, such as wages. The traditional export commodities are copra and cocoa, with plantation oil palm production by one commercial firm emerging as a third major export crop over the past two decades.

To date, the Solomon Islands government has pursued a bimodal approach to the development of agriculture, partly for historical reasons (Jones et al. 1988). A plantation or estate system has been encouraged alongside smallholder producers.

A recent study of income inequality in rural villages of Solomon Islands by Jones et al. (1988) gave lie to the proposition that Solomon Islands is an egalitarian society, at least where cash income inequality is concerned. Jones et al. used a common measure of inequality, the Gini coefficient, to measure cash income inequality; a summary of the results they obtained from four rural villages is presented in Figure 7.1. The most remote village with the lowest level of cash income per household which most closely resembles a traditional subsistence-based village—Haimarao—is the one with easily the most unequal distribution of cash income. The Gini coefficient was 0.73 and average household income $489. The other three villages, all of which have rather high Gini coefficients, are representative of villages at quite different stages of commercialisation. Tamboko—the most commercially-oriented village with an average household cash income of $2253—had a Gini coefficient of 0.26, almost the same as that for Sumate which had an average household cash income of $1284. Manakwai had an average income similar to Sumate but a slightly higher Gini ratio of 0.32. These results suggest that the early stages of penetration of cash-earning activities in rural villages occur in a highly uneven manner.

Jones et al. also calculated Gini coefficients for land area and cash expenditure for these villages. Again, the coefficients varied quite considerably and were surprisingly high. The only exception was the bush village of Gwai'au which was added in the calculations of land Gini coefficients. A remote village with very little cash activity, it had a

Figure 7.1 Gini coefficients for income distribution in four rural villages in Solomon Islands



Source: Jones, Fleming and Hardaker 1988. *Smallholder Agriculture in Solomon Islands: report of the South pacific smallholder project in Solomon Islands 1985-86,* South Pacific Smallholder Project, University of New England, Armidale.

markedly lower Gini coefficient for land holding compared with the other four villages (0.12 compared with an average of almost 0.4).

Method

The notation used to construct the aggregate and decomposed extended Gini indexes is now described. It follows fairly closely the method of Stark, Taylor and Yitzhaki (1988). The standard Gini index is derived directly from the covariance of income with its cumulative frequency distribution. For a given series of household income Y, the Gini index (Gy) is

$$Gy = 2\text{cov}[Y, F(Y)]/\overline{Y} \qquad (1)$$

where $\overline{Y}$ is the mean of *Y*, and *F(Y)* is the cumulative distribution function of *Y*. Let *Yi* be the *i*-th source of household income where total household income *Y* contains *k* sources. Thus, $Y = \sum_{i=1}^{k} Y_i$, and the following components of the Gini index can be derived.

The share of income from the *i*-th income source as a proportion of total household income (*Si*) is

$$S_i = \overline{Y_i} / \overline{Y} \qquad (2)$$

where $\overline{Y_i}$ is the mean of income from the *i*-th income source; and

$$\sum_{i=1}^{k} S_i = 1$$

The factor Gini coefficient for income from the *i*-th income source (*Gi*) is

$$Gi = 2\text{cov}[Yi, F(Yi)] / \overline{Y_i} \qquad (3)$$

where *F(Yi)* is the cumulative distribution function of income from the *i*-th income source.

The Gini correlation coefficient for the *i*-th income source (*Ri*) is:

$$Ri = \text{cov}[Yi, F(Y)] / \text{cov}[Yi, F(Yi)]. \qquad (4)$$

This coefficient can be used to measure the degree of correlation between income from the *i*-th income source and household rankings in terms of total household income. Two properties of this coefficient, described by Stark et al. (1988), can be used to ascertain which members of a given population have derived more or less income from a particular income source

$-1 \leq R_i \leq 1$, *Ri* = 1(–1) if *Yi* is a monotonically increasing (decreasing) function of *Y*

Ri = 0 if *Yi* and *Y* in the general case are independent, or if *Yi* is a constant.

The Gini coefficient for total household income (*Gt*) is

$$Gt = 2\text{cov}[Yi, F(Y)] / \overline{Y_i}. \qquad (5)$$

The contribution of the *i*-th income source to total income inequality (*Ci*) is

$$C_i = G_i R_i S_i. \qquad (6)$$

From equation (6), it follows that

$$\sum_{i=1}^{k} C_i = \sum_{i=1}^{k} G_i R_i S_i = G_t.$$

The proportional contribution of the *i*-th income source to total income inequality (*Pi*) is

$$P_i = C_i / G_t = G_i R_i S_i / G_t \qquad (7)$$

where $\sum_{i=1}^{k} P_i = 1.$

The relative inequality ratio for *i*-th income source (*Ii*) is:

$$Ii = GiRiSi/Gt)/Si = Pi/Si. \qquad (8)$$

The relative marginal effect of *i*-th income source on total income inequality (*Mi*) is

$$Mi = (Gt/ei)/Gt = (GiRiSi)/Gt - Si = Pi - Si \qquad (9)$$

where *ei* is a percentage change in the level of the *i*-th source of income, and

$$\sum_{i=1}^{k} M_i = 0$$

The extended Gini index is derived by incorporating a parameter into the Gini index that reflects the degree of aversion to inequality which enables measurement of inequality under different equity value judgments. Let *v* be an 'equity weight' parameter of range $1 < v < \infty$. The extended Gini index of household income *Y* can then be defined as

$$Gi(v) = -v\mathrm{cov}[Yi,\ 1-F(Yi)]/\overline{Y_i} \qquad (10)$$

When $v = 2$, equation (10) becomes

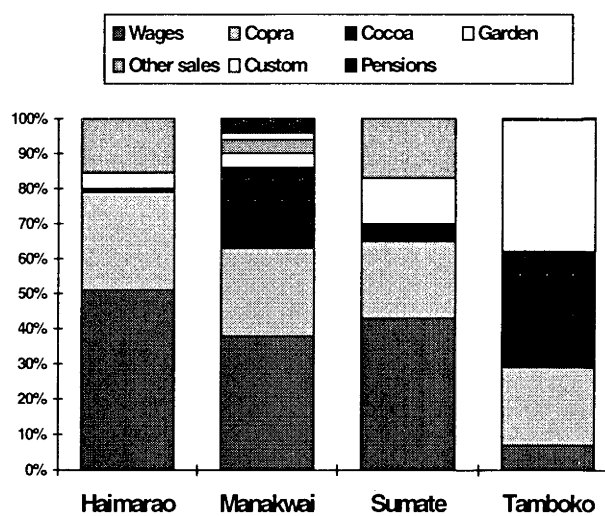
$$Gi = -2\mathrm{cov}[Yi,\ 1-F(Yi)]/\overline{Y_i} = 2\mathrm{cov}[Yi,\ F(Yi)]/\overline{Y_i} \qquad (11)$$

That is, the standard Gini index is a special case of the extended Gini index. When $v \neq 2$ and $1 < v < \infty$, the two indexes differ because the standard Gini assigns similar weights to all of the area between the 45 degree line and the Lorenz curve while the extended Gini assigns different weights to different portions of this area.

As in other empirical studies, the range of $1.5 \leq v \leq 4.0$ is considered in this study because changes in the values of v within this range reveal sufficient to understand the nature of changes in the extended Gini index and other relevant coefficients. A weight of $v = 1.5$ slightly favours inequality (smaller weights are attached to the lower end and larger weights to the upper end of the income distribution), while the weight of $v = 4.0$ strongly favours equality (considerably larger weights are fixed on the lower end with smaller weights attached to the upper end of the income distribution).

Procedures for decomposing the extended Gini index follow those for decomposing the standard Gini index. If the extended Gini correlation coefficient increases (decreases) as v increases, this implies that the correlation between income from the i-th income source and total household income is higher (lower) at the lower end of the income distribution (Stark et al. 1988:313).

Figure 7.2 Cash income shares by source in four rural villages in Solomon Islands



Shares of total cash income

Figure 7.2 contains a summary of the estimates of the shares of total cash income (*S*) by income source. Wage income contributes substantially to cash income in three of the villages, ranging from 51 per cent in the remote village of Haimarao to 38 per cent in Manakwai. Tamboko received the lowest share at seven per cent.

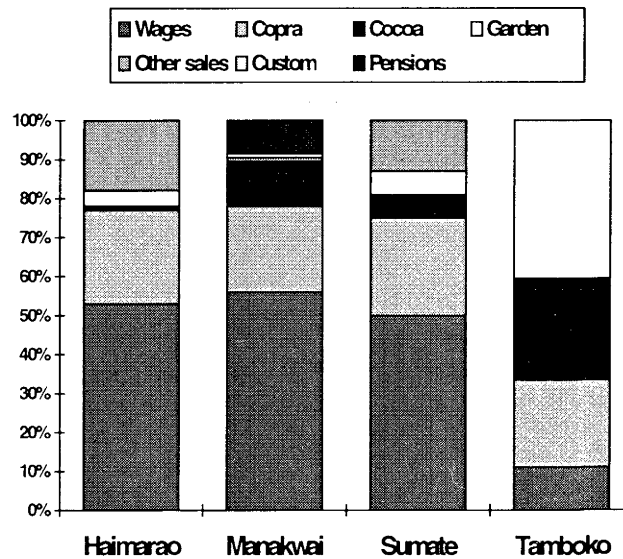
Cash crops accounted for most of the remaining contributions to income, reflecting their importance to village economies. Copra contributed the second highest proportion of cash income in Haimarao (28 per cent). Almost half of cash income in Manakwai was contributed by cash crops, equally divided between copra and cocoa. The smallest contribution from cash crops occurred in Sumate where 27 per cent is accounted for by copra (22 per cent) and cocoa (5 per cent). More than one-half of Tamboko's cash income came from cocoa (33 per cent) and copra (22 per cent) in Tamboko. The contributions by cocoa varied markedly across villages for two reasons. First, the amount of land suitable for cocoa production was limited, especially in Haimarao and Sumate. Second, only a small number of cocoa trees were of bearing age when the data were collected.

Garden income was found to dominate in Tamboko where it was the major source of cash income, accounting for 38 per cent. Sumate is the only other village in which it was significant contributor (13 per cent). These contributions reflect the relative proximity to markets of these two villages, particularly Honiara markets. Tamboko is west of Honiara and linked by a good road to the capital, providing opportunities for villagers to sell surplus fresh produce. Kunert (1986) reported that vegetable growing for commercial sale was widespread among villagers in Tamboko. Sumate is north of Honiara and linked by road and sea: villagers have reasonable access to markets.

Sumate and Haimarao are the only villages in which other sales were important contributors to income. These villages are coastal and villagers fish and collect shells from time to time. The ready availability of copra and food remnants also enabled them to raise pigs and chickens for sale. Tamboko and Manakwai have little such activity; although a coastal village, fishing is not common in Manakwai because the people there are fairly recent migrants from inland.

Low shares of income were obtained from custom payments or pensions and similar receipts in all villages.

Figure 7.3 **Proportional contributions to Gini coefficients by sources for income distribution in four rural villages in Solomon Islands**



Results of inequality estimates

Proportional contributions to income inequality

Proportional contributions to income inequality by income sources for the standard Gini coefficients in the four study villages are presented in Figure 7.3. The contributions of wages to income inequality were found to follow a similar pattern to the income shares of wages but to be generally higher, the result of high Gini correlation coefficients and factor Gini coefficients. This was particularly so in Manakwai where income share was 38 per cent but inequality contribution was almost 50 per cent higher at 56 per cent. The main explanation for this result is the high proportion of remittances in the wages figure, which are narrowly distributed among the village population. At least half of income inequality is attributable to wages in three of the four villages.

Cash crops accounted for most of the remaining contributions to income inequality in a fairly similar pattern to their shares of cash incomes. The main difference from wage contributions is that the inequality contributions by cash crops were less than their income shares in three of the villages, reflecting relatively lower impacts by the Gini correlation and factor Gini coefficients. The exception in this respect is Sumate where the inequality contribution was slightly higher than the income share due to a high factor Gini that reflects the uneven distribution of tree crop land in this village. In contrast, village households in Manakwai had become well integrated into cash cropping, especially in cocoa as a result of a major cocoa project. Consequently, the inequality contribution of cash crops (34 per cent) was well below their income share of 48 per cent.

The contribution by garden income to income inequality in Tamboko virtually mirrors its share of total income (40 and 38 per cent, respectively). The high proportional contribution to inequality is nevertheless a little surprising in light of the observation made by Kunert (1986) that vegetable growing for commercial sale was widespread among villagers. A high factor Gini coefficient indicates that not all households share in this activity. Perhaps the sexual division of labour in the village explains the result: men see themselves primarily as producers of tree cash crops, leaving the production and marketing of fresh garden produce predominantly to women. A low Gini correlation coefficient for garden income in Sumate is the main explanation for the surprising result that this source contributed only six per cent of income inequality but had 13 per cent of income share.

As noted, Sumate and Haimarao are the only villages in which other sales were important contributors to cash income, and they are the only villages in which other sales contributed significantly to inequality. In Haimarao, the inequality contribution was slightly higher than the income share (18 per cent to 15 per cent). In Sumate, it is the other way around, with an income share of 17 per cent but a proportional contribution to income inequality of only 13 per cent.

A highly unequal distribution of pension incomes in Manakwai is reflected in a very high factor Gini coefficient. As a result, pensions contributed twice as much to income inequality as to cash income. With this exception, low shares of income are the major reason that neither custom payments nor pensions and similar receipts contributed much to income inequality in any village.

Sensitivity of Gini coefficients to inequality aversion

Aggregate Gini coefficients increase significantly as greater emphasis is placed on the incomes of those households at the lower end of the distribution (that is, as the value of the equity parameter, *v*, is increased from 2.0—indifference about inequality—to 4.0—a high degree of sensitivity to inequity). As a general rule, the responsiveness of inequality contributions to increases in *v* declines.

Relatively little change in any village in the proportional contributions to inequality was found as the *v* parameter was increased. One exception to this general finding was when *v* was increased from 1.5 to 2.0: the proportional contribution by wages declined slightly in Manakwai and Sumate. This change is of little policy relevance given a preference expressed by the government for a high degree of equality in income distribution because it occurs in a range of values of *v* that implies indifference to or preference for inequality. Importantly for this study given particular interest in the impact on income distribution of cash cropping, proportional contributions to inequality by cash income from copra, cocoa and garden sales increased slightly as *v* approaches 4.0 in Manakwai and Sumate but not in the other two villages.

Marginal impacts of income sources on income distribution

Figures 7.4 to 7.7 present the effects on income distribution of a 1 per cent change in each income source in Haimarao, Manakwai, Sumate and Tamboko, respectively, for $v = 2$. The most striking impact in Haimarao (see Figure 7.4) is the income-equalising effect of an increase in copra income. For each one per cent increase in income from copra sales, there was a decline in the Gini coefficient of 0.04 per cent. In contrast to the marginal impact of copra, increases in both wages and other sales increased income inequality by around 0.02 per cent. Increased income from garden sales slightly reduced income inequality. It is worth noting, though, that all impacts declined as *v* was increased and became negligible when *v* was four, with the exception of wages.

Figure 7.5 shows that the major income-equalising impact at the margin in Manakwai came from cocoa. This result is consistent with the finding reported above that the contribution of cocoa to income

Figure 7.4 Effects on income distribution of a one per cent change in income sources in Haimarao

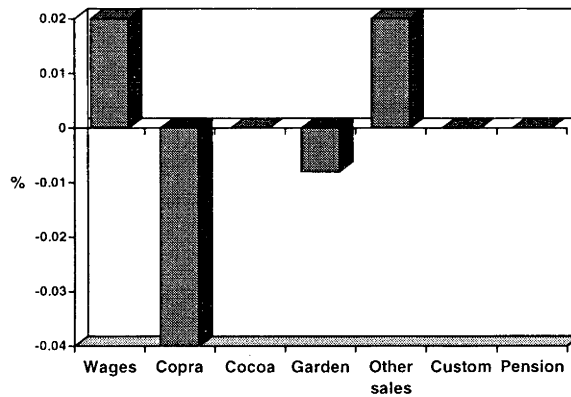


Figure 7.5 Effects on income distribution of a one per cent change in income sources in Manakwai

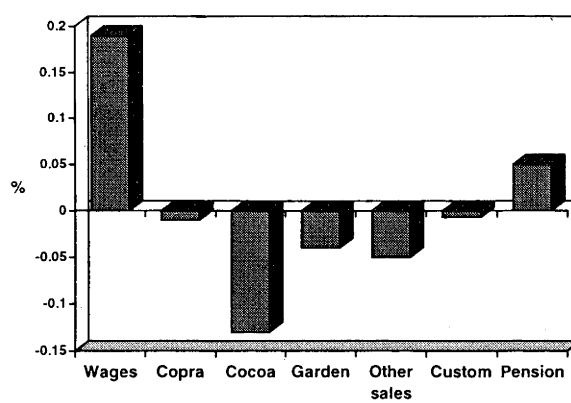


Figure 7.6 Effects on income distribution of a one per cent change in income sources in Sumate

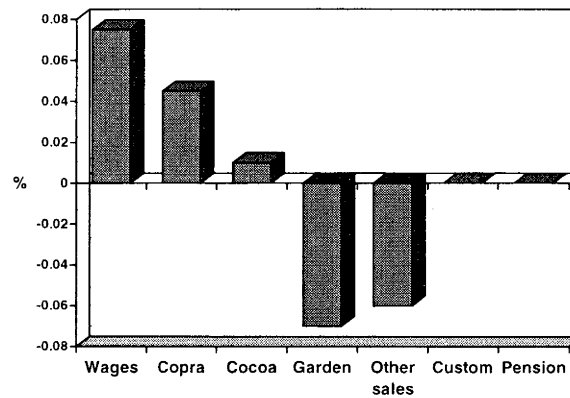
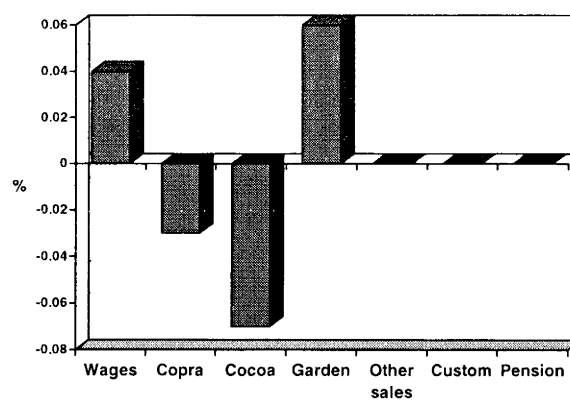


Figure 7.7 Effects on income distribution of a one per cent change in income sources in Tamboko



inequality was much less than its share of total income. For a 1 per cent increase in cocoa income, income inequality in Manakwai was reduced by 0.13 per cent. In contrast, and following a pattern similar to Haimarao, wage income increases had a substantial impact on inequality of income of 0.19 per cent. Other impacts were small, but worthy of note is the fact that a one per cent increase in pensions increased inequality by 0.05 per cent. These impacts declined only very slightly as v was increased. The rather surprising exception was income from copra the impact of which changed from slightly negative to increasingly positive (but still quite small).

As for the previous two villages, wage income increases had a strong effect on inequality of cash income distribution in Sumate: a one per cent increase had a 0.075 per cent positive impact on inequality (Figure 6). In contrast to the other villages, both cash crops also made income distribution more unequal at the margin, albeit to a relatively small extent (0.045 per cent and 0.01 per cent for copra and cocoa, respectively). Small but nevertheless significant negative impacts were made by garden and other income (–0.07 per cent and –0.06 per cent, respectively). Slight declines in impact were found generally with an increase in v, with the exception of wages for which the marginal impact became negligible by the time v was equal to 4.0.

Wages in Tamboko again had a positive marginal impact on inequality, this time of 0.04 per cent for a one per cent increase (see Figure 7.7). This impact was more than offset by the tree cash crops of cocoa and copra which had significant negative impacts on income inequality of –0.07 per cent and –0.03 per cent, respectively. The largest impact on inequality came from garden sales for which a one per cent increase resulted in an increase in income inequality of 0.06 per cent. There are a couple of interesting results as v was increased from 2.0 to 4.0. First, the equalising impact of cocoa income increased to 0.1 per cent. Second, as in Manakwai, the marginal impact of copra income changed from negative to slightly positive.

Strategic implications

Caution is needed in interpreting the results outlined above because they are based on past circumstances that might not extend into the future. Nevertheless, four interesting implications can be drawn. First, there is little evidence that cash cropping has substantial impacts on inequality of household cash income distribution in rural villages in

Solomon Islands. On the contrary, where it has taken place with reasonable access to cropping land and through projects that cover a wide cross-section of the village population, as in Tamboko and Manakwai for cocoa and Haimarao for copra, it can have a significantly beneficial impact on income distribution. There is at present a slightly disturbing matter concerning the beneficial impact of copra income. The copra industry has poor long-term prospects and there are doubts about the viability of the industry throughout the South Pacific. A decline in rural income derived from copra may well have an impact on inequality of rural cash income distribution, and the disappearance altogether of the industry could have very damaging equity effects unless other cash crop industries replace it with similarly widespread participation. As mentioned above, only cash incomes were considered in distribution measures, and subsistence income is likely to be much more equally distributed. Yet, to the extent that monetisation of the rural economy is inevitable, cash cropping seems a more equalising force in income distribution than other sources of cash income.

Second, wages appear to have the opposite effect on income distribution to tree cash crops, being the major force for more unequal distribution, in contradiction to the received wisdom among development analysts that increased wage income leads to more equal income distribution. The reason for this apparent anomaly is that opportunities for earning wage income are very restricted in rural villages in Solomon Islands; most opportunities are to be found in urban areas. The more remote the village from the main urban centre the fewer the wage-earning opportunities except for government employment. Ironically, then, government development efforts in rural areas are contributing more than any other source to growing income inequality.

Third, quite substantial differences in sources of income inequality between villages are reported above. Measures by government strategists to achieve economic growth, while not causing greater income inequality, need to be taken bearing this finding in mind. The most appropriate path to achieve the dual goals of growth with redistribution may not be the same for different parts of the country.

Finally, the above implications need to be considered in the context of the government's choice about its degree of aversion to inequality. Assessments of the impact of different economic activities on income distribution in villages change as attitude to inequality changes—or as different degrees of importance are attached to incomes earned by poorer sections of the rural community.

Primary export performance in Fiji, Papua New Guinea and Solomon Islands

Sospeter Onchoke and Euan Fleming

Export trade in the Melanesian countries of Fiji, Papua New Guinea and Solomon Islands consists mainly of primary products: agricultural commodities, fish, timber and minerals. As price takers for all exports, the three countries are highly exposed to external demand conditions. Much attention has been given to demand-side effects with the adoption of domestic polices to combat the destabilising effects of export prices. Apart from the use of commodity stabilisation funds, policy emphases of note have been (a) greater emphasis on import substitution through the imposition of import bans and tariffs, and (b) greater dependence on export and import taxes for government revenue. Current trends are towards freer markets. While agricultural export growth in the three countries is strongly affected by external demand conditions, it is conceivable that the countries could improve their export performance by being more competitive in the supply and quality of their exports and through export diversification consistent with a more liberal set of trade and marketing strategies. On the other hand, a return to more restrictive trade strategies by governments in the countries under study is likely to damage their export performance.

Agriculture's share of total commodity exports in the three countries has declined over the past three decades (See Onchoke, Chapter 6). This has been mostly due to export growth in other sectors but, in general, the growth rates of agricultural exports in these countries have not been impressive. On the other hand, certain non-agricultural primary exports have achieved substantial growth rates. Determining whether internal factors influencing export supply are more important than external demand conditions in primary export performance is the main goal of this study. It

should provide some guidelines for appropriate export strategies and policies, especially in terms of whether the trend to more liberal trade strategies has been justified.

Demand-side factors that reflect the external conditions faced by the exporting countries include world market influences, external trade strategies that affect the ability of the country to export, and special trade arrangements that distort world demand. In the empirical investigations carried out, demand-side factors for a given set of primary products a country exports are assumed to be reflected in the relevant world commodity export prices.

Supply-side factors refer to domestic production and marketing influences, and include the effect of government policies and exogenous events (such as natural disasters) on export performance. They are expected to affect the country's ability to expand exports through competition and commodity diversification.

Export strategies and performance in developing countries

Despite the recent trend towards more liberal trade regimes in developing countries, trade pessimism persists chiefly because developing country governments are pessimistic about trends in world market conditions for exports. Such trends are presumed to occur as advanced countries increasingly substitute raw materials with other inputs embodying advanced technology. Also, because many primary commodities often have low–income elasticities of demand in world markets, it is thought that little can be gained in the long term by specialising in the production of these commodities. This leads to advocacy of inward-oriented strategies such as import substitution and concomitant trade restrictions by governments seeking to protect their import-competing industries. Such sentiments also encourage governments to adopt export-led industrialisation strategies which lead to public support of manufacturing industries at the expense of primary industries.

However, import substitution under protectionist trade strategies in developing countries has been expensive, incurring foreign exchange and domestic production costs. Many analysts of trade strategies (Balassa 1978, Kavoussi 1984, Krueger 1990, Little, Scitovsky and Scott 1970) focused on the detrimental effects of restrictive trade strategies and argued

in favour of trade liberalisation. For example, Findlay (1984) argued for a balanced export-oriented growth. Duncan (1994:57) recently reinforced this message in the context of South Pacific countries by concluding that there 'is no support for import substitution policies in the performance of agricultural productivity growth, in the long-run trend in the commodity terms of trade, or in the long-run price elasticity of demand for primary commodities'.

The choice of pessimistic trade strategies in developing countries adversely affects primary export performance by reducing investment and profitability in primary industries, but it is not the goal in this study to assess the merits of different strategies. Rather, it is to determine whether world market demand imposes such a ceiling on developing country exports as made out by trade pessimists.

The success of the newly industrialised countries is often referred to as evidence of the benefits of trade liberalisation. However, the success of these countries has also depended on other factors such as the improvement of the domestic terms of trade facing the agricultural sector, use of labour-intensive technologies, large public investments in education and infrastructure, improvements in marketing facilities and institutions, and the combined commitment of the public and private sectors to achieve development goals. These features are not nearly as prominent in the economic sectors of Fiji, Papua New Guinea and Solomon Islands.

Assessment of primary export performance

In this section, a brief description is given of factors affecting primary export volumes and values, and policymaking in export sectors. Details of the composition of primary commodity exports and world market shares of the three countries under study are provided by Onchoke (1996:Chapter 8).

Factors affecting primary export performance

External factors. External factors are summarised as world demand. World market prices, total output or incomes (GDP) of the trading partners and changes in the competitiveness of substitutes are examples of factors widely accepted as the determinants of world demand.

Especially since the 1960s, arguments have been advanced supporting the prominence of external factors in affecting export performance of developing countries in general (Nurkse 1961; Prebisch 1964; Hazell, Jaramillo and Williamson 1990; Svedberg 1991; Streeten 1993; Liu, Chung and Meyers 1993) and specifically in respect of South Pacific countries (SPC 1980; Garnaut and Baxter 1984; World Bank 1988; Jolly, Beck and Bodman 1990). Most analysts who favour the establishment and operation of commodity-specific price stabilisation schemes believe in the prominence of external factors.

Domestic factors. Domestic factors with substantial impacts on export performance include policy interventions, size of domestic markets, producer prices, commodity composition and their market shares, direct financial incentives, agricultural research and extension services, and various other supply-side factors (Love 1984; Athukorala 1991). Even though many policymakers appear to underplay the influence exerted by domestic factors on export performance, it has now become clear that individual countries with appropriate domestic policies perform better in their export sectors (Athukorala 1991). This is evidenced by the superior export performance by the Southeast Asian countries compared with that of countries in sub-Saharan Africa and Latin America, under similar world market conditions.

With increased recognition of the influence of domestic factors, the importance of the supply-side factors for export performance is being given higher priority on the research agenda as is evident from the pioneering research by Kravis (1970) and empirical studies by Love (1984) and Athukorala (1991). According to Kravis, individual countries can achieve higher export performance by improving the market shares of their traditional exports, given external market conditions. In addition, export performance could be improved by diversifying a country's commodity mix into new product lines. Kravis called the improvement of the export market shares the competitiveness factor and diversifying the commodity mix the diversification factor.

While some domestic factors can be controlled, others are exogenously determined. Climatic conditions such as excessive rain, droughts and cyclones, the incidence of pests and diseases and civil disruption can all adversely affect export performance. Other environmental factors such as smallness, geographical isolation, and costly and infrequent access to major markets may also adversely affect the performance of export sectors in the Melanesian countries.

For example, a coup in Fiji in 1987, periodic cyclones, such as the devastating cyclone *Namu* in Solomon Islands in 1986, and the long-running civil war in Bougainville are some of the damaging events that have occurred. Geographical isolation means long distances from overseas markets and is compounded by the wide dispersion of islands within national boundaries. Unfavourable topography, such as rugged islands with mountainous hinterlands or flat atolls, make working conditions difficult and retard infrastructural and institutional development. In one way or another, these natural factors adversely affect the performance of Melanesian export sectors (Tsusaka 1984; Browne and Scott 1989; Fleming and Hardaker 1994).

Overview of trade strategies in Melanesian countries

Trade strategies can be classified into two major categories—export-oriented and import substitution—that are likely to have vastly different impacts on export performance. Strategies aimed at the production of commodities for external markets are export-oriented, or outward-looking, and tend to enhance export performance. Strategies directed towards the production of goods and services for domestic markets, mainly for the purposes of trying to replace previously imported goods (hence the term import substitution), are inward-looking and tend to detract from export performance.

The type of strategic orientation adopted depends on a country's trade objectives. As a result of trade pessimism, many developing countries adopted inward-looking strategies in the post-war period with emphasis on import substitution. Because of apparent failures of import-substitution strategies, however, an increasing number of developing countries adopted more outward-looking export promotion strategies from the mid-1960s (Milner 1988).

At one time or another, Melanesian governments have tried both strategies, sometimes simultaneously but usually consecutively. Until the mid-1980s, for example, trade policies in Fiji were based on import substitution, with manufacturing industries protected by various import tariffs and licensing restrictions. They were biased against export industries and, in some cases, resulted in low or even negative effective rates of protection. During the period 1975 to 1987, taxes on export transactions provided 23-30 per cent of government revenues (Delforce 1992).

In the late 1980s, particularly after the 1987 coup, Fiji adopted an export-oriented growth strategy and started to deregulate the economy. Initially, this deregulation included restraining government spending, and instituting tax reforms and a wages policy that recognised the importance of international competitiveness. In particular, high tariffs (of as much as 50 per cent to be reduced gradually within five years) replaced import quotas. Certain existing tariffs were reduced and, in 1988, new tax concessions were put into effect to promote manufactured exports. Export-oriented industries were exempt from import duties on all equipment and materials and were permitted not to pay tax on profits for up to 13 years (Browne and Scott 1989; AIDAB 1992b).

Before 1986, the exchange rate policy in Fiji focused on maintaining a stable real effective rate, accomplished through small but frequent adjustments of the nominal exchange rate against a basket of currencies to which the Fijian dollar was pegged. During the first half of the 1980s, the Fiji dollar experienced steady nominal appreciation, hampering the competitiveness of Fiji's exports. It then depreciated in value from 1986, opening up long-term opportunities for an export-led growth strategy (Browne and Scott 1989; AIDAB 1992b).

The history of trade strategy in Papua New Guinea has been mixed, although there is some evidence to suggest that, from independence, Papua New Guinea mainly adopted an export-oriented strategy. Despite commodity export taxes, the Papua New Guinea government established commodity-specific marketing boards and stabilisation schemes as part of an effort to develop its export sectors. While these boards and schemes were intended to promote export sectors, many have inhibited the expansion of those sectors due to high operating costs. Their net effect on export performance in PNG has probably been negative.

Export performancehas also been affected by the exchange rate policy. For a long period, the 'hard currency' policy (Goodman, Lepani and Morawetz 1987:53-54; Delforce 1992; AIDAB 1992a) resulted in an overvalued exchange rate which exerted an adverse influence on the export sector (Lam 1984:204). Depreciation of the kina against the US dollar between 1982 and 1986 was partly responsible for an increase in the volume of agricultural exports which rose by 27 per cent (Jarrett and Anderson 1989:24). In more recent times, exchange rate devaluations have been useful in improving export competitiveness (AIDAB 1991a).

Like Papua New Guinea, Solomon Islands has mainly practised export-oriented production (Browne and Scott 1989) with the marketing of copra and other export commodities controlled by the Commodities Export

Marketing Authority which operates along lines similar to boards in Fiji and Papua New Guinea. However, taxes on foreign marketing transactions increased in the 1980s: contributions by these taxes to central government revenue rose from 43 per cent in 1980 to 56 per cent in 1987. A greater proportion of these taxes is now from import duties, providing up to 80 per cent in 1987 compared with 55 per cent in 1980.

Exchange rate policy in Solomon Islands has been determined on the basis of a trade-weighted basket of currencies of the country's major trading partners. The Solomon Islands dollar depreciated by 50 per cent in the second half of the 1980s (AIDAB 1991b), improving the international competitiveness of exports.

In summary, government intervention in the selected Melanesian countries has affected agricultural producer prices both directly and indirectly. Direct government intervention to affect export performance has included price controls, imposition of tariffs, export taxes and import restrictions, and the operation of marketing boards and schemes with both monopolistic and monopsonistic powers. The most common indirect measure has been through exchange rate changes.

Method

The analytical basis for this study is that employed by Love (1984) and Athukorala (1991) who improved on the models applied by Kravis (1970). The advantage of their approach is that both demand and supply determinants of export performance are taken into account, as befits the assessment of competing hypotheses about primary export performance and its determinants. The factors of world demand, competitiveness, and commodity diversification are defined and measured using specific indices.

Two different analytical methods are used in this study, each of which has shortcomings. One is the use of time-series analysis techniques, the results from which suffer from the small number of observations available for the study (Onchoke 1996:75). The second is the use of standard econometric analysis to examine the impact of diversification on export performance. The main shortcoming of this approach is that it ignores problems created by cointegration between variables (as identified by Onchoke 1996), although it is not as susceptible as time-series analysis to problems created by small data sets.

Description of variables

As explained below, three explanatory variables are expected to have positive effects on export performance, measured in terms of competitiveness and diversification. Because the diversification variable is measured by a concentration index, however, the coefficients in this case are expected to be negative.

External market conditions. The external conditions for a particular product can be represented by the value of world trade in that product (Love 1984). For each sample country, a representative index of market conditions or world demand is formulated for agricultural exports. The construction of the index involves deflation of the shares of major agricultural commodities by a weighted-average index of constant (1961) price world exports of the relevant commodities. The world demand index is derived using the following formula:

$$WD_t = \sum_{i=1}^{j} Sa_{it} WX_{it} \qquad (1)$$

where

a_{it} = the share of commodity i in total agricultural exports in year t,

WX_{it} = an index of constant price world export of commodity i in year t,

S = market share of an export commodity, and

j = the number of major agricultural commodities.

The procedure of using world prices as deflators for the major commodities of a country is based on the assumption of the law of one price. This method is assumed to represent world demand for the internationally traded goods of the countries under study.

Competitiveness. The competitiveness of a country in regard to exports of a particular commodity should be reflected in its ability to increase its world market share. The impact on the shares of a country in world primary commodity markets through competition can be represented by the difference between its actual (observed) market shares and some arbitrarily measured market share norm or hypothetical market share.

Love (1984) measured the market share norm of a country as the average of the observed market shares in the initial four years of the study period. In this study, an average of market shares in the first five years was selected, to account for initial low shares for some commodities that were not developed as major exports in 1960.

The index of competitiveness is:

$$CM_t = \sum_{i=1}^{j} a_{it}(m_{it} / S_{it}) \qquad (2)$$

where

m_{it} = the actual market share of commodity i in year t, and
S_{it} = the market share norm of commodity i in year t.

The index series is derived by setting m/S_t equal to 100 for $t = 1$.

Diversification. Export diversification is estimated from the measure of the commodity concentration ratio in each year, following MacBean and Nguyen (1980). Thus, the diversification ratio is essentially the inverse of the commodity concentration ratio.

The Gini-Hirschman coefficient is used to construct the export diversification index. It is defined as:

$$DV_t = 100(\sum_{i=1}^{n}(X_{it}/\sum_{i=1}^{n} X_{it})^2)^{0.5} \qquad (3)$$

where

X_{it} = the value of exports of commodity i in year t, and
DV_t = the indirect measure of export diversification, and
the direct measure of export concentration, in year t.

Applying the Gini-Hirschman coefficient, the diversification index is constructed as:

$$DV_t = (\sum_{i=1}^{k} x^2{}_{it})^{0.5}$$

where

x_{it} = the share of commodity i in total exports,
k = the number of products a country exports, and
DV_t = 100 for $t = 1$.

The sum of the weights, $(\sum_{i=1}^{k} x^2_{it})$, represents the concentration ratio in year *t*. If a country is only exporting one commodity, the concentration ratio reaches its highest value of 100. A lower value would indicate the country has diversified its exports by increasing the number of commodities exported. The lower value is also an indicator of a more even distribution of exports (Athukorala 1991; MacBean and Nguyen 1980).

Data and period of analysis

Data were disaggregated to the SITC 3-digit level (UN Revision 2) to construct the series for the world demand and competitiveness variables. For both variables, commodities were selected which contributed one per cent or more to total primary exports during the first five years (1961 to 1965). These exports are defined for the purpose of this study as the principal primary exports. Only non-extractive primary exports were included because of the overwhelming influence that mineral exports had on export performance in Papua New Guinea during the study period. Four-digit numbers were used to classify coconut and palm products.

The principal primary exports for the countries under study are, for Fiji, sugar, molasses, coconut oil, timber and gold; for Paua New Guinea, coffee, cocoa, copra, coconut oil, tea, rubber, fish and timber; and for Solomon Islands, copra, cocoa, fish, timber and gold. Primary export performance in Fiji, Papua New Guinea and Solomon Islands was assessed using time-series data for the period 1961 to 1990. All variables—export values, world demand, competitiveness and diversification—were measured in constant terms and expressed as indices with 1961 equal to 100.

Annual time-series data for the study period were taken from Onchoke (1996: 436-8) for use in the econometric and time-series analyses. Onchoke obtained the data from individual country sources (*Quarterly Economic Bulletin of the Bank of Papua New Guinea, Current Statistics of Fiji, Statistical Year Book of Solomon Islands*), the *NCDS South Pacific Economic and Social Database for South Pacific Countries* (NCDS 1995) and various issues of the *Food and Agriculture Organization (FAO) Trade Yearbook, FAO Production Yearbook*, the *International Financial Statistics* published by the *International Monetary Fund*, the *FAO Yearbook of Fisheries, FAO Forestry Statistics* and the *UN Monthly Bulletin of Statistics.*

Econometric analysis

In the econometric analysis, estimates of world demand, competitiveness, and commodity diversification have been tested for their influence on the volume of exports (Athukorala 1991) or value of exports (Love 1984).

The model used by Athukorala is modified for this study, and expressed as:

$$EXP_t = f(WD_t, CM_t, DV_t) \qquad (4)$$

where

EXP = value of exports in constant prices,

WD = world demand,

CM = competitiveness in traditional primary exports,

DV = diversification of primary export commodities, and

t = time subscript.

Given external demand conditions for a given country, primary export performance depends on domestic supply-side influences through the ability to gain and maintain competitiveness in traditional export commodities and diversify the composition of exports into new product lines. These *CM* and *DV* factors capture the net effects[1] of the supply-side influences on export performance.

Economic theory does not indicate how the functional form of equation (1) should be specified. Athukorala (1991) used a log-linear functional form so that the coefficients could be interpreted directly as elasticities, while Love (1984) used a linear functional form. In this study, estimations are made using both linear and log-linear functions, and a *j*-test (Kennedy 1985:80) carried out to determine which model provided the best results.

The econometric model can incorporate other variables which are considered important in determining the export performance of a country. For instance, Love (1984) added a dummy variable to reflect the effects of a policy shift to a more liberal trade regime, which was expected to improve export competitiveness and diversification. Changes occurred during the study period in the external trade environment in each of the countries under analysis. Dummy variables were therefore included on the intercept and each of the three explanatory variables for the 1970s and 1980s (with the 1960s as the base) and for Papua New Guinea and Solomon Islands (with Fiji as the base). The 1970s reflected the early post-independence period in which substantial aid flows were received for primary industry development which should have been reflected in supply-side factors positively influencing primary export performance.

Indeed, as in the 1960s, substantial increases in primary export performance occurred in the 1970s in all three countries (Onchoke 1996: 436-8).

By the 1980s, aid weariness, growth in rent-seeking and a decline in the standards of government services are expected to have been associated with reduced competitiveness and worsening primary export performance. This negative trend might have been offset by moves to liberalise trade and the general economy, but liberalisation really only occurred in Fiji in the last three years of the decade, so the positive impacts of liberalisation on the competitiveness of traditional export industries and export performance are only likely to show up in that country during this period. Examination of the indices compiled by Onchoke (1996: 436-8) shows that primary export performance in Fiji stagnated for much of the 1980s before increasing substantially in the latter part of the decade, as expected, when the economy and trade were liberalised. However, the competitiveness index actually declined during that period. Primary export performance increased throughout the 1980s in Papua New Guinea despite a major decline in competitiveness in traditional export industries. In Solomon Islands, export performance and competitiveness both generally stagnated during the 1980s but with some volatility in the indices.

A pooled econometric model for all countries was estimated with a dependent variable representing export value in constant terms, independent variables representing world demand, export competitiveness and commodity diversification, and dummy variables (by decade and country) to reflect different trade environments over time and between countries. The inclusion of period and country dummy variables enabled the estimation of elasticities of response of export performance to each explanatory variable for each country in each decade of the study period.

Time-series analysis

A time-series analysis of primary export performance was undertaken, using the same indices and data series described above, to test for the influence of *WD*, *CM* and *DV* on primary export performance. The indices were first pretested for stationarity[2] and cointegration conditions. The unit roots and cointegration tests had to be undertaken before performing time-series tests on the optimal lag length determination, causality, FEDA and IRA. Tests for stationarity revealed the presence of unit roots but the order of integration was confirmed only after testing for the presence of unit roots in the difference forms of the indices.

Cointegration testing also used the two residual-based unit roots tests (ADF and PP) and a third non-parametric test, the Park-Ouliaris-Choi (POC) test. Causality testing followed the Granger type of specifications while FEDA and IRA were specified from the moving average representations of the reduced VAR models.

Results

Econometric analysis

Empirical estimates from the econometric analyses are presented in Table 8.1, with the explanatory variables explaining a very high proportion of variation in primary export performance. The *j*-test carried out to determine which model provides the best results was inconclusive, and results for the log-linear model are reported in Table 8.1 for the convenience of interpreting coefficients as elasticities. Individual dummy variables were included in the final model selected for presentation on the basis of *t*-tests at five per cent significance level using a two-tailed test given no prior expectations about the signs on the dummy variables. Individual intercept dummy variables for decade and country were all found to be insignificant, and are excluded from the selected model. Results are reported and discussed for each of the three explanatory variables in separate sections which follow.

World demand

Results for the world demand variable are unexpected with the exception of the 1970s and 1980s in Fiji. They show some variation in export response to world demand conditions across countries and decades. During the 1960s, the insignificant coefficient on the base world demand variable suggests that it was not a factor influencing primary export performance in any country. This situation prevailed throughout the whole study period in Solomon Islands, but not in Fiji or Papua New Guinea. In Fiji in the 1970s and 1980s, world demand exerted a strong positive impact on primary export performance, as expected, with an elasticity not significantly different from unity in both decades. The fact that there is no significant difference in elasticity between the 1970s and the 1980s suggests that the liberalisation that occurred in the Fijian economy in the

Table 8.1 Empirical estimates factors influencing primary export performance in Fiji, PNG and Solomon Islands

Variable	Coefficient	Standard error	t-value
Constant	4.989	0.752	6.631
World demand	-0.138	0.130	-1.064
Competitiveness	0.852	0.094	9.023
Diversification	-0.796	0.142	-5.622
World demand: Fiji 1970s	1.062	0.116	9.182
World demand: Fiji 1980s	1.079	0.118	9.121
World demand: PNG 1970s	1.018	0.240	4.246
World demand: PNG 1980s	-1.372	0.520	-2.636
Competitiveness: Fiji 1970s	-0.864	0.109	-7.957
Competitiveness: Fiji 1980s	-0.846	0.116	-7.308
Competitiveness: PNG 1970s	-0.839	0.229	-3.667
Competitiveness: SI 1970s	0.726	0.119	6.092
Diversification: SI 1970s	-1.189	0.172	-6.910
Diversification: PNG 80s dummy	1.996	0.672	2.971
Buse R^2	0.976		
Log of the likelihood function	44.869		

late 1980s did not lead to any greater exposure of primary exports to ceilings imposed by world demand during the 1980s. The dominance of sugar exports has been picked up by this variable in Fiji with massive world price increases from 1972 reflected in substantial increases in the value of sugar exports from F$32 million in 1970 to $117 million by 1979 (NCDS 1995). The opposite effect is observable in the 1980s, with a decline in the world demand index dominated by the situation in the world sugar market: sugar exports declined as a proportion of total exports from 57 per cent in 1980 to 35 per cent in 1990 (Onchoke 1996: 428). In Papua New Guinea, a significant elasticity is reported for the 1970s, similar to that in Fiji. Surprisingly, however, a significantly negative impact was recorded for the 1980s.

The result for Solomon Islands can be explained by the nature of primary industry development. While the study period was indeed one in which the traditional primary export industry—copra—was being greatly influenced by world market events, the influence of this industry on overall exports waned dramatically during this sub-period (NCDS 1995). It was a period when new export industries were being developed, and their development bore little relationship to the states of the world markets in the industries concerned and much more to the opening up of exploitation of existing marine, forestry and land resources.

Overall, results suggest structural change in world markets for Fiji and Papua New Guinea beyond the 1960s. The change in Fiji suggests that world demand has emerged as a major influence on primary export performance, reflecting in particular the constraints on export expansion imposed by the world sugar market structure and conditions. Papua New Guinea appears to have experienced two periods of structural change with opposing influences on export performance. The 1970s were a decade in which world market conditions for primary export commodities—both agricultural and mineral—played a major role in influencing primary export performance. By the 1980s, export performance was dominated by domestic supply factors influencing the mining industry, which by then accounted for around two-thirds of total primary exports, and agriculture. While world demand factors no doubt continued to play a role in agricultural export industries, their relative contribution to total primary exports had declined significantly and domestic factors influencing competitiveness, such as the outbreak of coffee leaf rust in the coffee industry, civil strife in the major cocoa-producing province of North Solomons and the impacts of major production projects in forestry and the oil palm industry, also played a part in the dramatic decline in the influence of world demand on primary export performance.

Competitiveness

The effects on primary export performance of the competitiveness variable are only partly in line with the expectations outlined above. The coefficient on the variable is significant and of expected sign (and insignificantly different from unity) for all countries during the 1960s and for Papua New Guinea and Solomon Islands during the 1980s. The 1960s saw an upsurge in smallholder planting and production of traditional agricultural commodities (for example, sugar in Fiji, coffee and cocoa in Papua New Guinea and coconuts and cocoa in Solomon Islands) which had a marked positive impact on primary export performance.

Competitiveness was, surprisingly, not an important influence on primary export performance in any country during the 1970s, although a significant but small elasticity of 0.126 was recorded for Solomon Islands. The 1970s in Fiji were a period of substantial world sugar price increases between 1971 and 1975, followed by a build-up in world supply in which Fiji did not share to any great extent until 1979 (NCDS 1995). Fiji's share of world sugar trade fell from 1.5 per cent in 1966-70 to 1.1 per cent and 1.3 per cent in 1971-75 and 1976-80, respectively (Onchoke 1996: 223).

Competitiveness remained a negligible influence on primary export performance in Fiji during the 1980s, reflecting the fact that liberalisation had its major impact in encouraging the emergence of new export industries rather than increasing the competitiveness and export performance of traditional industries. But it did revert to being a significant factor in Papua New Guinea and Solomon Islands during this decade, with a decline in competitiveness in traditional export industries associated with a decline in primary export performance. Domestic conditions became less favourable for both smallholders and estates producing traditional commodities, especially compared with the situation in many developing countries which were relative newcomers in these markets and which had much lower production costs.

Diversification

The expected positive impact of diversification on primary export performance is revealed in all but one country in one decade—Papua New Guinea in the 1980s—where, as for world demand, an unexpected sign was recorded. Impacts were consistently strong throughout the study period in both Fiji and Solomon Islands. The unexpected result for Papua New Guinea is explained partly by the fact that diversification had come to a halt by the end of the 1970s, and there was in fact a return to greater concentration between 1980 and 1986 (Onchoke 1996: 437). Competitiveness factors assumed greatest influence on primary export performance during this decade.

The high coefficient on the diversification variable in Solomon Islands in the 1970s (–1.985), which is significantly higher than the competitiveness and world demand variables, is explained by the fact that Solomon Islands changed from having a highly specialised agricultural export economy to a broader primary export base during this decade (NCDS 1995), which greatly improved primary export performance. Palm oil and fish exports expanded rapidly, and major projects, by Solomon Islands standards, occurred in these industries. For example, the fishing industry was promoted through large investments by the government and private interests and, on occasions, was supported by incentives such as company tax rebates. Diversification within the agricultural sector was made possible largely through government initiatives with the development of the palm oil industry. However, the development of this crop is confined in terms of location and suitable agricultural land.

Summary

Diversification generally exerted a greater positive influence on exports than either world demand or competitiveness, although it is evident that competitiveness has been quite a strong influence. Overall, the results suggest that export performance in the three countries is relatively more sensitive to domestic supply factors than to world demand conditions for primary commodity exports.

Time-series analysis

Empirical findings are presented and discussed in this section under the headings of unit roots, cointegration, Granger causality, FEDA and IRA test results.

Unit roots test results

Using the SHAZAM applications, the data series of the four indices—total exports (*EXP*), *WD*, *CM* and *DV*, respectively—were tested for unit roots, first in logarithmic levels and then in first difference logarithms.[3] Data in logs were first tested for the presence of one or more unit roots (also referred to as testing for the order of integration—one I(1) or higher).[4] The unit roots results for Fiji, PNG and Solomon Islands were obtained for three models: no constant plus trend variable; constant but no trend variable; and constant plus trend variable (Onchoke 1996: 231-3). All reject the stationarity hypothesis for all variables in most models in levels, but accept the hypothesis in first difference models, implying that the variables in these series are at least I(1).

Test statistics for Fiji in all data series in the three models are significantly greater than their respective critical values at 10 per cent level for ADF and PP tests and 5 per cent for the PC test. Hence, the three tests fail to reject the hypothesis of non-stationarity for *EXP*, *WD*, *CM* and *DV*. Without further unit roots testing it is difficult to tell whether the series are I(1) or higher. To check the integration order, the data series were tested for unit roots in the first difference forms of the data series. Almost all the test statistics in the first difference forms are significantly smaller than their

respective critical values, confirming that the data series are non-stationary with an I(1) process. To conduct further statistical estimations of these indices, they should be differenced once to make them stationary.

Similar results to those for Fiji were obtained for PNG and Solomon Islands. Based on these results, therefore, all the indices were transformed to first differences prior to further statistical estimations.

Cointegration test results

The possibilities of long-run equilibrium relationships were investigated given that the indices are I(1). All seven combinations of the explanatory indices were tested when conducting the cointegration regression analyses of export performance to ascertain which combination best captures the cointegration relationship:

$$lnEXP_t = f(lnWD_t, lnCM_t, lnDV_t) + Z_{1t}$$
$$lnEXP_t = f(lnWD_t, lnCM_t) + Z_{2t}$$
$$lnEXP_t = f(lnWD_t, lnDV_t) + Z_{3t}$$
$$lnEXP_t = f(lnCM_t, lnDV_t) + Z_{4t}$$
$$lnEXP_t = f(lnWD_t) + Z_{5t}$$
$$lnEXP_t = f(lnCM_t) + Z_{6t}$$
$$lnEXP_t = f(lnDV_t) + Z_{7t}$$

Three residual-based cointegration tests (ADF, PP and POC) were applied to each residual (Z_{it}, $i = 1, ..., 7$) in the above set of equations for two models: constant and no trend; and constant with trend.[5] The results for Fiji revealed cointegration in the model with constant and no trend in only two equations, (1) and (3), by both ADF and PP tests at 10 per cent significance levels. These equations had *WD*, *CM* and *DV* as explanatory variables in one model, and *WD* and *DV* in the other model.

No test detected any cointegration in any model for PNG. For Solomon Islands, cointegration was found in both models of equations (2) and (6) and the constant with trend model of equation (5). Variables in equation (5) were found to be cointegrated at the 10 per cent significance level by the PP test only while variables in equations (2) and (6) were found cointegrated by both ADF and PP tests at 10 per cent level of significance.

Since non-cointegrating relationships were found to dominate, estimation in VAR models appears the most appropriate approach. Due to the small sample sizes, statistical estimations were conducted in VAR models in log levels in addition to first differences.[6]

Granger causality test results

Because the results of Granger causality are sensitive to the proper selection of lags, all indices were first tested for optimal lag lengths. Two tests were employed—the Akaike information criterion (AIC) and the Schwarz criterion (SC). The optimal lag length results are presented in Table 8.2 alongside the observed test statistics of Granger causality for the VAR models in both levels and first differences.

Fiji. Results for Fiji indicate that one year is the optimal lag length for all seven equations in VAR models in levels and first differences (Table 8.2). Granger causality was detected in the VAR models in levels only, with the direction of causation in equation (3) from *WD* and *DV* to *EXP* at the five per cent significance level. It was also obtained in equations (4) and (7), running from *CM* and *DV*, and *DV* alone, to *EXP* at five per cent and 10 per cent significance levels, respectively. Results suggest that *WD* factors have causal relationships with *EXP* only if they are specified with *DV*. Similarly, *CM* and *DV* specified together are causally related with *EXP* but, when the two domestic factors are specified individually, only *DV* has a causal relationship with *EXP*.

The results for Fiji show that domestic factors are important in determining *EXP*, and are more important than the external factor, *WD*. These results confirm that Fiji had lost competitiveness in its principal export commodities (sugar and coconut oil) over time, but gained export market shares from new[7] product lines (fish and timber products) so that diversification increased.

PNG. Optimal lag lengths and Granger causality results for PNG are also reported in Table 8.2. Lags as long as four years were found to be optimal.

Granger causality was detected in various specifications of the VAR models in both levels and first differences. For example, causality runs from all three variables to export performance in equation (1) in both levels and first differences at one per cent and five per cent significance levels, respectively. Evidence of causality for *WD* and *DV* is strong in equation (3), being statistically significant at one per cent in levels and first differences. In equation (4), *CM* and *DV* were statistically significant at one per cent in levels and five per cent in first differences. Of the two domestic supply factors, *DV* appeared to be more important, brought about principally by very strong growth in the mineral export sector. When the

explanatory factors were specified individually, the domestic supply side factors seemed more important causal factors in enhancing export performance than *WD*.

The causality results for PNG appear to confirm the evidence for Fiji. As traditional agricultural export industries have declined, PNG apparently maintained export performance while at the same time diversifying its exports into copper, gold and palm oil.

Solomon Islands. The lag length and Granger causality test results for Solomon Islands are not very different from those for PNG and Fiji. Table 8.2 shows optimal lag lengths as long as three years. The three variables, *WD*, *CM* and *DV*, at levels and in first differences in equation (1) of the VAR models help predict export performance at one per cent and five per cent significance levels, respectively. This was true for equation (2), involving *WD* and *CM*, and equation (3), involving *WD* and *DV*. Individual specifications indicate that *WD* (equation (5)) is significant at 10 per cent in first differences and *DV* (equation (7)) is significant at the 10 per cent level in levels. Hence, Solomon Islands results show that all three factors have a stronger causal relationship with export performance when specified together. The domestic factors were quite important when each was specified with *WD*.

The Granger causality results for Solomon Islands confirm the evidence presented above. Solomon Islands has also been diversifying its export portfolio into products such as palm oil.

FEDA test results

Variance decomposition applying FEDA supplements the causality test results and permits quantification[8] of the responses of one variable, for example exports, to disturbances in its own or other variables—*WD*, *CM* and *DV*—within a given system. FEDA was performed for the VAR models in both levels and first differences, and results are presented in Table 8.3.

Fiji. Results for Fiji indicate that own shocks (from exports) had the greatest impacts (Table 8.3), followed by *DV* the effects of which increased with time. *WD*, with a decreasing influence over time, had the third largest impact and *CM*, the impacts of which increased up to year eight and then decreased, had least impact for the VAR models in levels. The considerable impact of *DV* is consistent with the causality results.

Table 8.2 Causality test results from demand and supply factors to export performance for selected Melanesian countries

Direction of causality from	VAR in levels Optimal lags AIC	SC	Test statistics	VAR in first differences Optimal lags AIC	SC	Test statistics
Fiji						
(1) WD, CM & DV	1	1	2.25	1	1	1.58
(2) WD & CM	1	1	0.89	1	1	0.08
(3) WD & DV	1	1	3.49**	1	1	0.98
(4) CM & DV	1	1	2.57*	1	1	2.13
(5) WD	1	1	0.1	1	1	0.07
(6) CM	1	1	1.84	1	1	0.02
(7) DV	1	1	5.26**	1	1	1.42
PNG						
(1) WD, CM & DV	3	3	5.79***	3	3	4.06**
(2) WD & CM	-	2	1.74	2	2	1.15
(3) WD & DV	3	-	1.17	-	-	-
(4) CM & DV	4	4	5.23***	3	3	4.90***
(5) WD	3	3	4.41***	3	3	3.58**
	3	3	1.56	2	2	2.23
(6) CM	-	2	3.36*	2	2	1.6
	4	-	1.38	-	-	-
(7) DV	4	4	4.66**	-	3	4.97**
	-	-	-	4	-	4.74**
Solomon Islands						
(1) *WD, CM & DV*	-	-	-	-	1	4.25**
	3	3	5.90***	3	-	3.63**
(2) *WD & CM*	-	-	-	-	1	4.25**
	3	3	3.50**	2	-	3.80**
(3) *WD & DV*	-	-	-	1	1	6.64***
	3	3	5.38***	-	-	-
(4) *CM & DV*	-	1	2.24	1	1	0.5
	2	-	2.04	-	-	-
(5) *WD*	-	-	-	1	1	3.51*
	2	2	2.32	-	-	-
(6) *CM*	-	-	-	1	1	1.05
	2	2	2.45	-	-	-
(7) *DV*	-	1	4.22*	1	1	0.93
	3	-	2.95*	-	-	-

Notes: Test statistics are based on critical values of *F*-distributions.
* Significant at 10% level, ** Significant at 5% level, *** Significant at 1% level.

In the VAR models in first differences, results pointed in a similar direction, albeit with different magnitudes (Table 8.3) with *WD* and *DV* changing places in importance of impact. Most impacts stabilised at year eight. These results were obtained even though causality was not detected in the first difference VAR models.

PNG. Decomposition results for Papua New Guinea in Table 8.3 are consistent with the causality findings reported above. For the VAR models in levels, export contributions were greatest, increasing from year one to two and decreasing consistently thereafter. *WD* followed in importance but its impact decreased from year one towards year 20. On the other hand, the impacts of *CM* and *DV* increased over time, with the latter greater than the former.

Results for the models in first differences depict much the same message and are consistent with the findings of the causality tests. Impacts seem to stabilise at year eight.

Solomon Islands. Decomposition results for Solomon Islands in Table 8.3 are also quite consistent with causality results. The models in levels show that *WD* had the strongest impact on export performance, initially increasing to year three and then starting to decrease towards year 15. The second most important factor, *DV*, contributed increasingly to *EXP* to year 10, after which the impact decreased to year 20. Similar impacts were shown by *EXP* on itself and CM, with the latter having easily the smallest impact.

For the models in first differences, contributions were different and stabilised at year 10. The results indicate that, while *WD* was important, domestic factors were even more important in determining export performance, with the relative impact of *CM* much stronger than for the model in levels.

IRA test results

IRA is a technique to evaluate the impacts of random shocks on a particular variable, and other variables in a system, by tracing deviations in their responses the expected time path.[9] If the variables in the VAR are non-stationary, and the VAR is estimated in levels, the resulting impulse responses may not settle for many periods, which is further evidence of non-stationarity.

Table 8.3 Variance decompositions of export performance for selected Melanesian countries

(Percentage export sector decompositions)

Period	World demand	Competitiveness	Diversification	Exports
Fiji levels				
1	42.5	7.8	0.7	49
3	29.5	18.7	12.2	39.6
5	23.1	22	21.5	33.3
8	19.6	22.4	30.5	27.5
10	18.8	22.2	34.1	24.9
15	18	21.8	38.8	21.3
20	17.6	21.8	41	19.6
Average	24	19	26	31
Fiji first differences				
1	35.5	2	0.1	62.4
3	29.5	3	14.8	52.7
5	29.3	3.4	14.8	52.5
8	29.3	3.4	14.8	52.5
10	29.3	3.4	14.8	52.5
15	29.3	3.4	14.8	52.5
20	29.3	3.4	14.8	52.5
Average	30	3	13	54
PNG levels				
1	44	9.7	0.9	45.4
3	22.7	4.1	20.2	53
5	13.9	5.5	30.2	50.4
8	9.5	8.5	34.7	47.2
10	8.4	9.9	35.6	46.1
15	7.2	11.7	36.2	44.9
20	6.8	12.3	36.3	44.5
Average	16	9	28	47
PNG first differences				
1	37.7	10.5	0.1	51.7
3	24.7	9.7	18.8	46.8
5	24.1	9.6	19.5	46.8
8	24.1	9.6	19.5	46.8
10	24.1	9.6	19.5	46.8
15	24.1	9.6	19.5	46.8
20	24.1	9.6	19.5	46.8
Average	26	10	17	47

Table 8.3 continued

Period	World demand	Competitiveness	Diversification	Exports
Solomon Islands levels				
1	50.5	5.7	17.5	26.3
3	56.7	3.7	24.4	15.2
5	52.5	5.1	31.7	10.7
8	38.9	8.3	41.5	11.3
10	32	9.9	44.5	13.6
15	25.8	11.4	44.2	18.6
20	26.6	11.4	41.4	20.6
Average	40	8	35	17
Solomon Islands first differences				
1	29.8	17.3	17	35.9
3	18.4	32.2	10.1	39.3
5	20.8	30.7	10	38.5
8	20.7	30.8	9.9	38.6
10	20.7	30.8	9.9	38.6
15	20.7	30.8	9.9	38.6
20	20.7	30.8	9.9	38.6
Average	22	29	11	38

Impulse responses in VAR models in levels and first differences are graphed in Figures 8.1 to 8.6 for Fiji, Papua New Guinea, and Solomon Islands.[10]

Fiji. The impulse responses for Fiji are quite persistent for the VAR models in levels (Figure 8.1). A one standard deviation shock in *WD*, *DV* and *CM* produced quite big and persistent responses in export performance. Responses from *CM* were initially quite substantial but tended to diminish with time, especially after year five. Responses from *DV* were small and slowly increased.

Responses were found to be fairly transitory in the VAR models in first differences (Figure 8.2). They are all large initially, but begin to collapse after year two and converge to zero by year eight. Overall, the results confirm those found in the previous models of FEDA and causality, that both external and domestic factors influence primary export performance.

PNG. IRA results for Papua New Guinea are graphed in Figures 8.3 and 8.4. The magnitude and persistence of responses in export performance to unexpected shocks in WD, CM and DV have been maintained to year 20 and perhaps beyond (see Figure 8.3). They appear least for DV.

Results based on the VAR models in first differences imply responses that collapse to near zero from year 8 to 10. Responses to *WD* and *DV* are strong, but they are weak for *CM*. Generally, these results accord with those obtained previously from the FEDA and causality models.

Solomon Islands. Results of the IRA in Solomon Islands are portrayed in Figures 8.5 and 8.6. Response patterns indicate more persistence and greater magnitudes for the VAR models in levels than in first differences (Figure 8.6), although the initial response to *WD* is much larger in first differences. The most persistent and strongest responses in magnitudes for the model in level comes from *CM*, but *WD* response is also great. The results are generally, but not universally, in line with those obtained from causality tests.

Strategic implications

The results of the econometric analyses undertaken in this study support the hypothesis that successful supply strategies create an environment conducive to better primary export performance in Fiji, Papua New Guinea, and Solomon Islands. Conversely, an unfavourable export environment detracts from a competitive primary export sector and has a negative impact on primary export performance. Consistent with the findings of Athukorala (1991), it appears that the competitiveness and diversification factors have been more important than world demand in explaining changes in the export performance of these countries. Results from the time-series analysis are slightly different in that fairly strong evidence was found in all countries that both external and domestic factors influence primary export performance, with direction of causality from the factors to export performance. Both FEDA and IRA results generally support the causality results in finding that external factors contribute substantially and with reasonable persistence to primary export performance, and domestic factors have a strong and sometimes persistent influence on primary export performance. Nonetheless, as for the econometric evidence, substantial evidence was obtained for the influence of diversification on export performance.

The importance of the diversification variable suggests that attempts at diversification have largely been successful in bringing about trade creation rather than trade diversion. The high degree of concentration on a narrow range of primary commodities for their exports in the countries before the 1960s changed thereafter, a result of diversification of the

Figure 8.1 Responses of export performance in VAR models in levels, Fiji

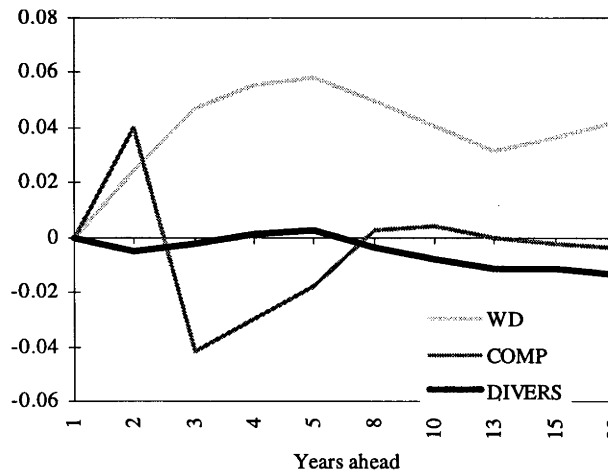


Figure 8.2 Responses of export perfromance in VAR models in first differences, Fiji

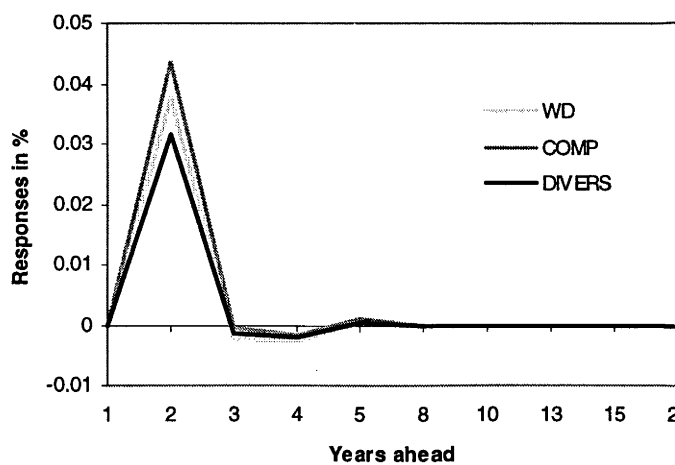


Figure 8.3 Responses of export performance in VAR models inlevels, Papua New Guinea

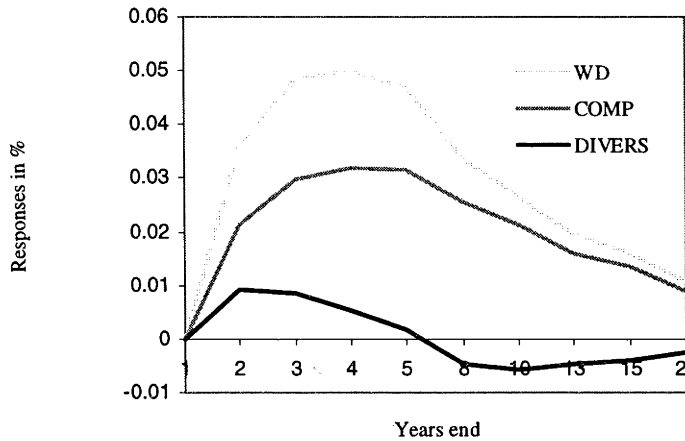


Figure 8.4 Responses of export performance in VAR models in first differences, Papua New Guinea

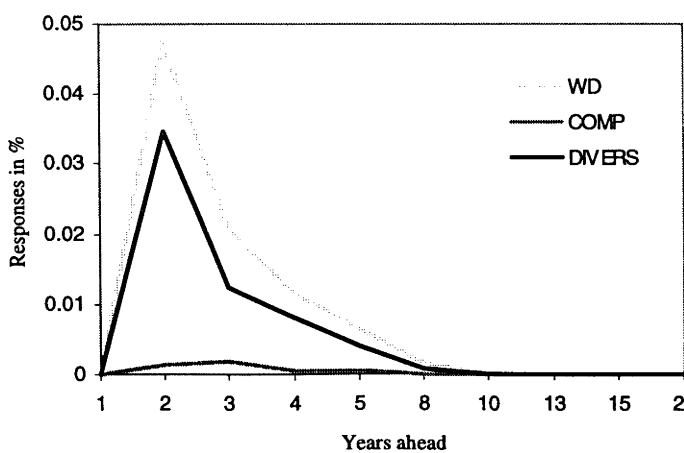


Figure 8.5 Responses of export performance in VAR models in levels, Solomon Islands

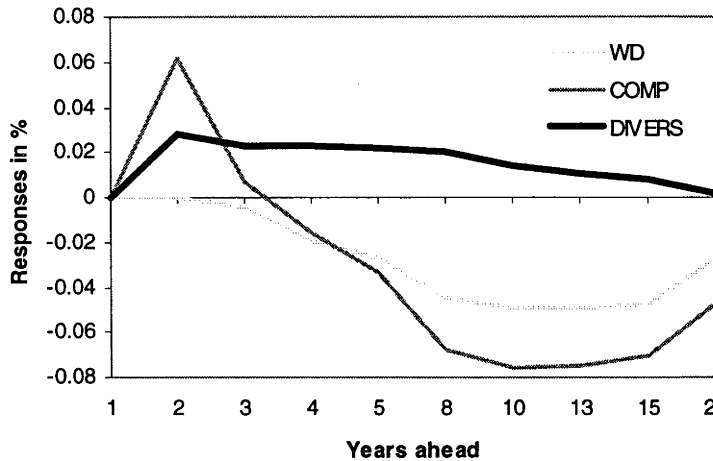
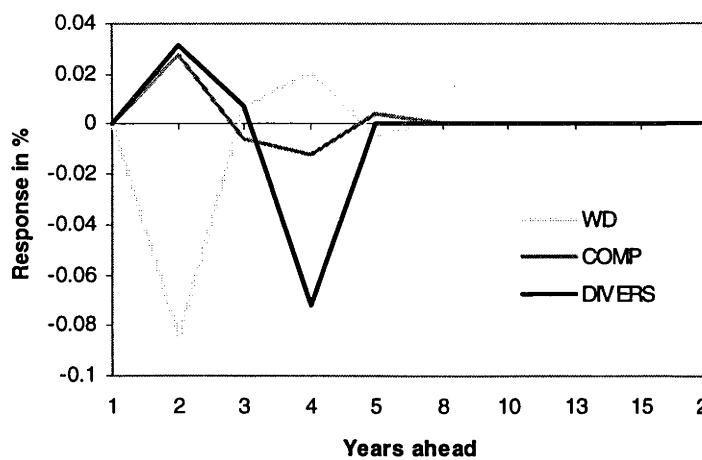


Figure 8.6 Responses of export performance in VAR modles in first diefferences



commodity mix into new, non-traditional product lines. As dependence on traditional agricultural products started to diminish, new (mainly non-agricultural) primary commodities emerged and strongly influenced primary export performance. This diversification became important as international competitiveness in traditional agricultural exports waned, reflected in their reduced market shares in world markets and disappointing export performance.

The limited effects of world demand on the export performance of the countries in the econometric analysis could be partly explained by domestic polices which have caused distortions in the trade of certain commodities. In particular, prices of commodities administered by marketing boards rarely reflect world demand due chiefly to the operation of price stabilisation schemes and high marketing costs. Market information to producers may also be out-of-date or unreliable.

Given the importance of supply-side strategies in export performance in all countries, more attention should be given to factors such as research and technology, infrastructure and marketing support services. In particular, industry competitiveness is likely to be a major determinant of export performance in the future, given that most substantial opportunities for diversification have probably already been realised. Hence, government support for the private sector is crucial in developing exports in the countries under study, providing an environment conducive to private participation in trade-related activities and to the development of primary exports in general.

Attention should be given in particular to research and technology. Krugman (1990: Chapter 9) highlighted the role of technology not just as the driving force in international trade and specialisation but also as the means of retaining a competitive edge in an export market. There is a need for Melanesian countries to find some really effective improved farming methods that smallholders can and will take up to bring about a substantial rise in resource productivities and incomes. Such improvements are mainly achievable through more and better agricultural research and extension, although it is not just a question of expanding these activities on the same basis as in the past. In many Melanesian countries much of the extension effort to date has been ineffective because there have been few improved methods to promote. Improved agricultural research is needed, yet the capacities of small island nations for such research are obviously limited. It is important, therefore, that the research that is done is both relevant and effective. A sharper focus on relevant

problems can come through forging closer links between the researchers and smallholders (who take most farming decisions) than have existed in the past, for example, by more on-farm studies. Effectiveness can be improved by tapping in more fully to the international knowledge network so that researchers avoid duplicating work done elsewhere and can concentrate on applied and adaptive research, passing on more basic problems to better equipped research units overseas. This requires more regional and international cooperation. Australia and New Zealand, as major aid donors in the region with good skills in agricultural research, should be able to contribute here if some of the petty rivalries that presently inhibit cooperation can be overcome. Similarly, there is a case for more involvement in the region by some of the international agricultural research centres.

It is pointless for improved production techniques to be made available to producers if they cannot get access to the needed inputs of information, materials and credit at reasonable cost, or if they cannot sell their output for a reasonable return. Action here is largely a matter of better primary product marketing, broadly defined, and prescriptions boil down to the three Is—infrastructure, information and institutions.

Development of rural infrastructure is vital to link primary producers more closely to markets and to reduce costs of transporting goods to and from those markets. The capital involved in infrastructural improvement will be large but the Melanesian countries have the advantage of being recipients of aid flows that are high on a per person basis by international standards. These flows need to be more carefully directed to projects of long-term benefit to rural people. Moreover, international experience suggests that rural development projects based on construction of infrastructure have a higher chance of success than many of the other initiatives commonly taken to promote rural development (World Bank 1987).

There has to be a better flow of information between primary producers and potential buyers about what is needed. This requirement is most obvious in export markets. For example, there is a trend in higher income countries to 'gourmet' consumption wherein 'different' and special foods are in strong demand. These trends create market niches that Melanesian smallholders might fill very profitably, but generally do not fill at present because the information about the opportunities does not filter back to them. There is imperfect flow of information in local markets too. Knowing what the buyers want and when they want it can allow producers to match

production more closely to demand and so reap higher prices. Part of the problem appears to be related to the need for reform of marketing institutions, as discussed below.

Institutional arrangements for primary product marketing need to be reviewed in the Melanesian countries which opted in the past for statutory marketing boards to sell traditional exports. Studies of marketing throughout the region imply that marketing boards can bring advantages in operations in export markets but they also have their drawbacks, especially if monopoly powers mean that they do not face the stimulus of competition required to ensure they remain sharply efficient and if they lack autonomy from political interference. Moreover, the world market situation and opportunities have changed over the years, requiring marketing institutions to adapt to take best advantage of these changes in circumstances. It seems that the costs of market failure that can occur when marketing is left in private hands have not been properly balanced against the costs of political and administrative failure from too much intervention by governments. For various reasons, such as the small pool of able people relative to the number of jobs to be done and the intrusion of family or clan ties into decision making, administrative failures seem to be more common in small countries. It is being widely recognised in diverse countries that governments need to emphasise their facilitative roles and avoid involvement in activities better left to the private sector. Such thinking has not yet spread to all public decision makers in Melanesian countries where an overly interventionist style of public administration still persists. In agricultural marketing, the failings of this approach too often impede progress and stifle initiative.

Endnotes

Chapter 1

1 Throughout the text, import values refer to f.o.b. at the source country. NSO has only recently begun collecting c.i.f. import values. Data on imports come from both the NSO and the statistical offices of the food exporting countries.

2 This may be due to classification differences but errors can not be ruled out. Gibson (1993b) found large differences between PNG import quantity data for various meats and the matching Australian and New Zealand export data.

3 The simultaneous introduction of health services with cash cropping clouds the issue somewhat.

Chapter 3

1 These figures relate to models with different compositions and time lags. The analysis by Jolly et al. (1989) was based on two-year time lag and aggregate figures for all sectors (0.18). In Overfield's (1991) study, the estimate of smallholders' elasticity (0.27) was based on a model with a one-year lag ; confidence intervals (0.04 to 0.47) were wide at the 95 per cent level.

2 Intercropping intensity varies considerably, so the actual production (income) impact is unknown. It could be just a couple of banana plants in a coffee garden or extensive intercropping of coffee and sweet potato.

3 Based on incomes produced under 100 per cent coffee cropping in the same trial.

4 Gross imperfections in the 'household labour market' explain why the marginal opportunity cost of female labour is nevertheless much lower than for male labour, referred to above. In particular, there is far from perfect substitutability between male and female labour, its degree being socially and culturally determined.

5 Coffee price support is dependent on the views of the political party in power. The government at the time of writing was Highlands-based; this level of support could not reasonably be expected to be sustainable.

6 A prime example of this is CIC, formed in 1991 to provide all the research, extension and industry regulation for coffee alone.

Chapter 4

1 The border price of a commodity refers to the f.o.b. export price if the country is an exporter of the commodity and to the c.i.f. import price if the country is an importer of the commodity.

2 The term, social, is used here as equivalent to 'economic' in benefit-cost analysis.

Chapter 5

1 Including time allocated to outside work which is dropped for estimation purposes.

2 Figures in parentheses are *t*-ratios. An asterisk on the coefficient denotes that it is significant at the 5 per cent level using one-tail test and of expected sign. Where the coefficient sign is uncertain, a two-tail test is used.

3 Most cross-sectional data tend to be 'noisy' due to variations caused by numerous factors which vary from one household to the other, but which cannot be easily captured by variables. As it is not easy to purge the data of such 'noise' due to the difficulty in identifying the source of the noise, the analyst has to live with the reality that the data used are 'noisy'. Whether or not parameter estimates derived from equations with low explanatory power are useful depends on the purpose of the study. When the aim of the research is to test the statistical significance of parameters, a low R^2 by itself does not invalidate such tests. On the other hand, if the purpose of the study is to forecast the joint effect of several independent variables on the dependent variable, models with low R^2 values tend to be less reliable. In the context of the present study, a low R^2 is not a major problem as the main purpose of the study is to use the estimates for significance testing, not for forecasting.

4 The time allocated to farm activities is defined as the sum of the time allocated to food garden and cash crop production.

5 The objective of food self-sufficiency may be difficult to attain and may not necessarily be desirable. However, examination of this issue is beyond the scope of this research.

Chapter 6

1 Measured as the sum of service credits, unrequited transfers and net capital flows.

Chapter 7

1 It should be stressed that these coefficients are for cash income only as no estimates were imputed for subsistence income. The latter tends to be much more equally distributed than cash income and, if it were included, the coefficients could be expected to decline substantially, especially in Haimarao.

2 Following Jones et al. (1988), household cash income per head was divided into seven categories or sources for this study: wages, copra sales, cocoa sales, garden crop sales, other income, custom payments received, and pensions or similar receipts. Data compiled by Jones et al. covered four villages: Haimarao, on the remote weather coast of Guadalcanal (24 households); Sumate, in Western Guadalcanal (21 households); Manakwai, on the north-west coast of Malaita (21 households); and Tamboko, on Guadalcanal reasonably close to the capital, Honiara (20 households).

3 More detailed analysis of the sensitivity of inequality measures to equity considerations in the four villages is provided by Maeaba (1993).

Chapter 8

1 The supply-side factors are the sum of all domestic factors, both spontaneous and policy-induced (Love 1984).

2 The same three unit roots techniques applied in Chapter 2 (the augmented Dickey-Fuller (ADF) test, Phillips-Perron (PP) test and Park-Choi (PC) test) are used to test for the order of integration.

[3] Use of data series in logarithmic forms for all the indices means the estimated coefficients can be interpreted directly as elasticities.

[4] If a series is found to be integrated of an order greater than zero, it is said to be non-stationary. This series needs to be differenced to make it stationary, or integrated of order zero. It is checked by testing for unit roots of difference data.

[5] These tests are commonly known as 'residual-based tests for cointegration' which are performed by estimating the static cointegrating regressions, followed by the ADF, PP and POC tests conducted on the estimated residuals (Z_t) from the static cointegration regressions. Results are reported in detail by Onchoke (1995: 236-8).

[6] This is because the unit roots tests are based on asymptotic results, and thus their power in small samples is highly reduced. Estimation of VAR models in levels helps to preserve degrees of freedom and keeps the data intact without losing useful information (Doan 1990; Ramachandran and Kamaiah 1992). Fuller's (1976) theorem shows that, even if it is appropriate, differencing produces little gain in asymptotic efficiency in an autoregression and, particularly in VARs, loses information. For instance, while almost no gain is obtained, simple VARs on differences cannot capture co-integrating relationships (Doan 1990).

[7] The word 'new' is used in the sense that these commodities had not been traditional export commodities in large quantities prior to the study period.

[8] Quantification of causality results refers to the fact that, if causality has been detected, for example, running from one direction to another, there are possibilities of making inferences about the directions in which the impacts are greater and more persistent. Magnitudes and persistence of the impacts can be measured by FEDA and IRA, respectively (Baffes and Shah 1994).

[9] Impulse responses describe a persistent or transitory impact on one variable of shocks to itself and other variables (Baffes and Shah 1994). Given that the impulse responses do not settle for the VAR models in levels, the findings for both IRA and FEDA from the VAR models in differences should be taken as more reliable than those from VAR models in levels.

[10] Responses are shown in percentage changes to one standard deviation shock to other variables.

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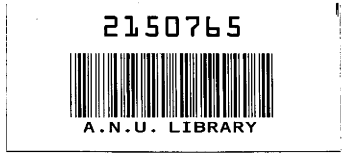

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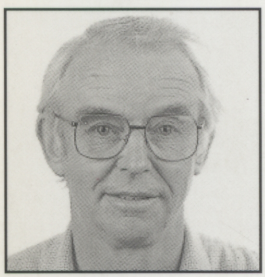

'Despite a lack of supporting quantitative evidence, Papua New Guinea's food policy is based on the twin beliefs that per capita food production is falling, and the country is becoming increasingly reliant on imported food. However, the evidence surveyed challenges these beliefs. The results from existing food import substitution attempts should caution policymakers against further interventions that create inequitable taxes on poor households, reducing agricultural employment and undermining export competitiveness' (Gibson, Chapter 1).

This volume brings together a number of papers dealing with similar strategic issues in the economic development of Melanesian agriculture. A broad range of development issues are discussed ranging from the economics of food import substitution in Papua New Guinea to women's time allocation in rural areas in Solomon Islands.

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