THE PRICE ELASTICITY OF DEMAND FOR PAPUA NEW GUINEA EXPORTS OF COCOA AND COFFEE

John Gibson[1]

ABSTRACT

The price elasticity of demand for Papua New Guinea exports of cocoa and coffee is calculated using the perfect substitutes model of world trade. Econometric estimates are made of the world price elasticity of demand for cocoa and coffee. These estimates are combined with data on Papua New Guinea's world market share, supply responses in competing countries, and price transmission elasticities in consuming and producing countries to calculate own-price elasticities of demand of at least -11 for cocoa and -12 for coffee exports. These estimates show that Papua New Guinea can safely increase production of cocoa and coffee without fear of causing prices, and export revenues, to fall significantly. If protection for import-substituting industries increases domestic costs, cocoa and coffee producers will be made worse off because they are unable to pass these extra costs forward to foreign consumers.

Key Words*: Elasticity of demand; cocoa; coffee; Papua New Guinea.*

INTRODUCTION

If a country exports a product facing an inelastic export demand by the rest of the world, increasing supply will simply lower prices and reduce export revenues. The best policy, in this case, is to exploit the inelastic demand by restricting supply and forcing up prices. It may also be sensible to switch attention towards substituting for imports as a means of increasing employment and incomes, and improving the balance of payments. Higher domestic costs often result when tariff or quota protection is given to import substitution industries: studies suggest that a ten percent tariff increases exporters' domestic costs by at least five percent (Clements and Sjaasted 1984, Chiao and Scobie 1989). If exporters face an inelastic demand they have sufficient market power to pass some of these costs forward to overseas consumers. Therefore, the cost increases caused by import protection do not have their usual taxing effect on exporters, although they may still cause losses for domestic consumers.

It has traditionally been assumed that this inelastic export demand does not characterise Papua New Guinea (PNG) and other Pacific Island economies. Instead, these countries are presumed to face elastic demand curves and have no influence on world prices because of their small contribution to world production and trade (Lam 1979, Gimbol 1992). Increased import protection is not economically sensible for such price-taking countries because it simply transfers income from exporters to import-competing producers.

Recent policy decisions to close the PNG border to imports of cement and tinned fish and to increase tariff levels to ten percent raise the question of whether policy makers in PNG have rejected old assumptions and now perceive export demand to be inelastic. For instance, it seems unlikely that policy makers would deliberately want to help large, foreign-owned industries (e.g., fish canners) take income away from smallholder exporters (e.g., cocoa producers), yet this is what is implied by high import protection in a small price-taking economy. In searching for economic - as opposed to political - reasons for changes in import protection policy, it is necessary to re-examine the evidence on the elasticity of export demand.

Some analytical support for a revised (i.e., inelastic) view may be provided by Kauzi (1992)

[1] Food Research Institute, Stanford University, CA 94305, U.S.A. Formerly with Planning, Programming and Budgeting Division, Department of Agriculture, Konedobu, Papua New Guinea.

who has estimated a price elasticity of demand for total Papua New Guinea exports of -0.326. This means that a one percent reduction in the price of PNG exports (perhaps following devaluation) would increase the quantity demanded by only 0.3 percent. This inelastic demand suggests that cutting prices does not make sense because the quantity response is so low that total revenue falls. Therefore it is a matter of some importance for economists to establish which assumption about export demand elasticity is the most appropriate. This paper contributes by estimating the elasticity of demand for exports of cocoa and coffee. These two crops are selected because they generate more employment and have more favourable price trends than any of the other tree crop exports (Gibson 1992).

METHOD

The perfect substitutes model of world trade is used. This model is appropriate for homogeneous commodities such as cocoa and coffee that are traded on organised international markets (Goldstein and Khan 1985). The quantity of world exports (X_w) equals the sum of country i's exports (X_i) and the exports of the rest of the world (X_r). Thus, country i's export price elasticity of demand $(\eta_x)_i$ can be related to the world price elasticity of demand for exports $(\eta_x)_w$ and to the price elasticity of export supply $(\varepsilon_x)_r$ in the rest of the world:

$$(\eta_x)_i = (X_w/X_i)(\eta_x)_w - (X_r/X_i)(\varepsilon_x)_r \qquad (1)$$

Equation (1) was derived by Horner (1952) and has been frequently used to estimate export demand elasticities. Examples include Colombian coffee (Johnson 1970), Ghanaian cocoa (Blomqvist and Haessel 1972) and New Zealand meat and dairy products (Scobie 1973). Gardiner and Carter (1988) provide a complete survey.

One objection to equation (1), which has been raised independently by Bredahl, Meyers and Collins (1979) and Cronin (1979), is the assumption that world commodity markets are operating freely. Rather, it may be the case that consumers in importing countries and farmers in cocoa and coffee producing countries face local prices that are insulated from world price fluctuations. Several policies could ensure this: variable export taxes and subsidies, state operated marketing boards buying at administered prices, and variable levies or quotas in consuming countries.

The economic effect of such insulation is to reduce the export demand elasticity facing Papua New Guinea. If consumers and competing producers face insulated prices, they will respond less to price changes made by PNG exporters because those price changes will not be completely transmitted to them. As written, equation (1) assumes perfect price transmission, so the elasticity of prices in each country, with respect to PNG export prices ($\varnothing_{rji}$), is equal to one and therefore makes no explicit appearance in the equation. With imperfect price transmission ($\varnothing_{rji}$ <1 for at least some of the j countries) the estimate of $(\eta_x)_i$ falls and at the extreme of $\varnothing_{rji}$=0 for both consuming countries and competing exporters, $(\eta_x)_i$ falls to zero and PNG faces totally inelastic export demand. The following parameters are needed for estimating equation (1) for Papua New Guinea exports of cocoa and coffee:

- own-price elasticity of world demand for co coa (coffee)
- own-price elasticity of supply by all cocoa (coffee) producers, except PNG,
- Papua New Guinea's share of world cocoa (coffee) exports.

Over 75 percent of cocoa and coffee is consumed in non-producing countries so exports should be an acceptable measure of total world demand, and supply elasticities for producing countries should equal export supply elasticities. A survey of previous studies provided estimates for $(\eta_x)_w$ and $(\varepsilon_x)_r$, and the author's estimates of $(\eta_x)_w$ were also used.

Estimates are also required for the $\varnothing_{rji}$, the transmission elasticities. These provide information regarding the appropriateness of the free market assumption underlying equation (1). If it is assumed that PNG export prices are based on some overseas market price, such as the New York "Other Milds" coffee market price, estimates of the price transmission elasticity from world prices to domestic prices in each of the j countries can be used instead of estimating $\varnothing_{rji}$. Estimates of world price transmission elasticities are provided by a recent study (Mundlak and Larson 1992).

Behrman (1968) estimated cocoa demand elasticities for major importing countries. The weighted average own-price elasticity was -0.24 and the income elasticity was 0.8. UNCTAD (1974) estimated an own-price elasticity for world cocoa demand of -0.41. Islam and Subramanian (1989) estimated the own-price elasticity of demand for total cocoa exports by all developing countries as -0.19 and the income elasticity as 0.18.

UNCTAD (1974) estimated own-price elasticities of coffee demand as -0.92 for Western Europe and -0.49 for the United States. Singh and de Vries (1977) estimated the own-price elasticity for the U.S. as -0.22 and for the rest of the world -0.26. Akiyama and Duncan (1982) estimated own-price and income elasticities for eight groups of countries and weighted the results to give elasticities for the world. The own-price elasticity was -0.23 and the income elasticity was 0.45. Islam and Subramanian's (1989) preferred own-price elasticity was -0.27 and the income elasticity was 0.47. Yeboah (1991) estimated a very low own-price elasticity of world coffee consumption of -0.09 and an income elasticity of 0.66.

There is substantial variability in the elasticity estimates made by previous authors. This is caused by different data samples and time periods, and especially by the use of different econometric equations.The more recent estimates seem to have smaller own-price elasticities but income elasticities follow no coherent pattern. To provide more robust and up-to-date elasticity estimates, developed country demand for cocoa and coffee was econometrically modelled. Developed countries import over 90 percent of world exports of cocoa and coffee, and consume 80 percent of cocoa production and 70 percent of coffee production (FAO 1992). Thus, they provide a good representation of world demand. Ordinary least squares regression was used with an autoregressive, distributed lag specification:

$$Q_t = \alpha_1 Q_{t-1} + \beta_0 + \beta_1 P_t + \beta_2 P_{t-1} + \beta_3 Y_t + \beta_4 Y_{t-1} + u_t \qquad (2)$$

where: Q = per capita consumption of cocoa (coffee)
P = real price of cocoa (coffee)
Y = real per capita income
u = random error
t = time period.

By applying appropriate restrictions to α_1 and β_i equation (2) encompasses nine econometric specifications commonly used by economists (Hendry 1989). It especially allows for the fact that people only partially adjust their consumption, within one time period, to changes in prices and incomes. The long run response of consumption to price changes and to income changes is given by $(\beta_1 + \beta_2)/(1-\alpha_1)$ and $(\beta_3 + \beta_4)/(1-\alpha_1)$. Equation (2) forms a general starting point and more restricted equations can be estimated if the data are consistent with those restrictions.

Estimates of supply elasticities for cocoa, coffee and many other agricultural crops have been surveyed by Askari and Cummings (1977). Short run own-price elasticities of cocoa supply range from 0.15 to 0.68, with corresponding long-run elasticities ranging from 0.45 to 1.81. Short-run supply elasticities for coffee range from a low of 0.07 for Colombia and 0.10 for Brazil, to 0.28 for other Latin American countries and 0.29 for Indonesia (Askari and Cummings 1977, Akiyama and Duncan1982).The long-run supply elasticities calculated by Akiyama and Duncan are quite high: 0.96 for Colombia, 1.05 for Indonesia, 1.10 for Brazil, with a weighted world average of 0.74 (the corresponding weighted short-run elasticity was 0.12).

Variability in supply elasticities may be explained by the share of each country's exports contributed by the crop. Short-run supply elasticities tend to be low when a crop makes a major contribution to exports; high prices only bring an increased harvesting intensity because most available land is already being used for the crop. It is also felt that smallholders can not bring new areas into production as quickly as can estates (Singh and de Vries 1977). Also, when the crop is an important source of income for a large number of smallholders there is more chance that government will prop up prices to maintain household incomes during times when world prices are low. This will reduce the downward supply response.

Estimating a 'world' supply elasticity is likely to be less successful than estimating a world demand elasticity because the substitute products are less well defined on the supply side. In some countries cocoa is competing for land with palm oil, in others with coconuts, and in others with Robusta coffee. In some countries there is almost no competition for coffee growing land whereas tea competes in others. Therefore, equation (1) is estimated using three assumed values of $(\varepsilon_x)_r$: 0.1, 0.3, and 0.7. These correspond to short-run, inelastic; short-run, elastic; and long-run, average values of the supply elasticity. This allows for the temporal aspect of the elasticity of demand facing Papua New Guinean exports. There is less market power in the long-run because other countries can respond to high prices by bringing new areas into production.

Transmission elasticities from world agricultural prices to domestic prices have been estimated by Mundlak and Larson (1992). They find that for most crops and most countries, most of the variation in world prices is transmitted to domestic prices, contrary to the popular belief. The average price transmission elasticity of coffee prices in 23 producing countries was 0.65 and for 15 cocoa producers (although Ghana and Ivory Coast were not in the sample) it was 0.86. Less evidence was presented on the price transmission in consuming countries, except an estimate of 0.86 for coffee prices in the United States. Price transmission should be close to perfect for consuming countries because they have no domestic cocoa and coffee producers to protect with variable levies or quotas. Therefore, assuming values for $\varnothing_{rji}$ of 0.65 in producing countries and 0.8 in consuming countries is likely to be quite conservative. Equation (1) is estimated using both these conservative assumptions and the free market assumptions ($\varnothing_{rji}$=1).

DATA

Data on aggregate developed country population, cocoa and coffee imports (quantities and unit values in US$), and consumption (imports adjusted for exports and stock changes), were obtained from FAO's AGROSTAT.PC database. The FAO definition of developed countries includes the OECD, minor European states, Eastern Europe, Israel, and South Africa. The food import unit value index for the whole world (1979-81=100) was used to deflate cocoa and coffee unit values. Unit values for substitute and complement products (tea, sugar) were also collected.

The income variable used was the weighted average real GDP per capita for OECD countries, expressed in a common set of international prices (Summers and Heston 1991). Although only applying to a subset of the countries that consumption is modelled for, the per capita income variable is the best available because of the unreliable nature of GDP estimates in the formerly centrally-planned economies. Data were available for the period 1961-1988.

ESTIMATION RESULTS

Variables are in logarithms so coefficients can be interpreted directly as elasticities. Equation (2) was estimated over the period 1962-1988 (with 1961 data used for the *t*-1 terms). Initial results for the model of per capita cocoa consumption were:

$$Q_t = \underset{(0.17)}{0.53Q_{t-1}} - \underset{(0.03)}{0.14P_t} + \underset{(0.05)}{0.04P_{t-1}} + \underset{(0.04)}{1.08Y_t} - \underset{(0.36)}{0.75Y_{t-1}} - \underset{(1.11)}{2.82}$$

$R^2 = 0.93$, $F_{(5,21)} = 56.45$, AUTO(1): $F_{(1,20)}$=0.01

ARCH(3): $F_{(3,15)} = 0.37$, NORM: $X^2_{(2)} = 0.58$

HETERO: $F_{(10,10)} = 0.49$, RESET(3): $F_{(2,19)} = 1.37$

The figures in brackets are standard errors. R^2 and F are conventional 'goodness of fit' statistics: the model explains 93 percent of the variation in per capita cocoa consumption and the group of coefficients are statistically, significantly different from zero. AUTO(1) is the lagrange multiplier test for first-order autocorrelated residuals (which give biased standard errors and biased and inconsistent coefficient estimates when there is a lagged dependent variable, as here). Unreported tests showed that higher order autocorrelation was not present. HETERO and ARCH are the lagrange multiplier tests for heteroscedasticity (due to squares of the variables, and due to lagged, i.e., autoregressive, terms), which also biases standard error estimates. NORM is the lagrange multiplier test for normality of the residuals (non-normality invalidates the inferences from other test statistics). RESET(3) tests for misspecified functional form by adding squares and cubes of the predicted values to the set of regressors and testing if the added variables have statistically significant coefficients.

The initial model satisfied all diagnostic tests. There was no evidence of excluded relevant variables. Real unit values for sugar, coffee, and tea were each added to the model. Estimated coefficients were not statistically significant (the most significant addition was sugar, $p<0.23$). The estimated coefficients suggest that previous cocoa consumption has a strong influence on current consumption. Prices and incomes are also very influential. A one percent increase in the real cocoa price will reduce consumption in the same period by 0.14 percent. The long-run price elasticity is -0.21, with a standard error of 0.06.

The only simplification of the initial model that did not involve imposing restrictions that were rejected by statistical tests was the removal of the P_{t-1} term. The resulting model also satisfied all diagnostic tests. The long-run elasticities were almost unchanged, with an estimate for the own-price elasticity of -0.22 (standard error 0.05). Thus, an estimate of -0.21 for the world price elasticity of demand for cocoa exports seems to be supported by this data.

Initial results for the model of per capita coffee consumption were

$$Q_t = \underset{(0.56)}{-0.08Q_{t-1}} - \underset{(0.11)}{0.15P_t} - \underset{(0.05)}{0.03P_{t-1}} + \underset{(0.61)}{1.22Y_t} - \underset{(0.49)}{0.75Y_{t-1}} - \underset{(1.55)}{3.03}$$

$R^2=0.83, F_{(5,21)}=20.64$, AUTO(2): $F_{(2,19)}=2.93$

ARCH(1): $F_{(1,19)}=1.01$, NORM:$X^2_{(2)}=1.65$

HETERO: $F_{(10,10)}=5.44$, RESET(3): $F_{(2,19)}=1.39$

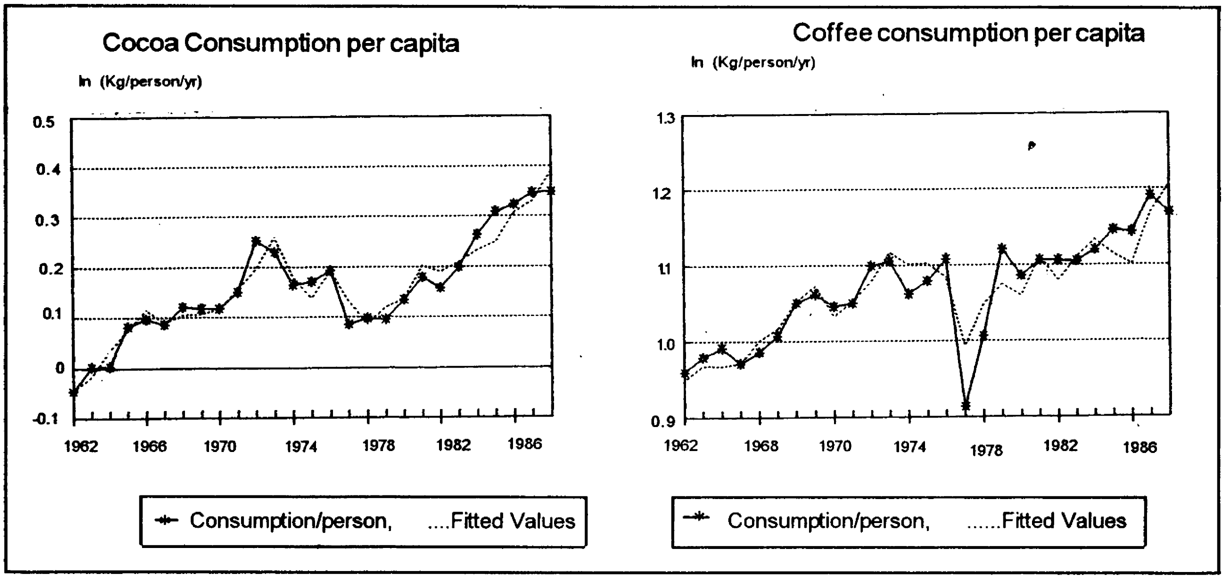
The standard errors are calculated using the White (1980) estimator, and are robust to the heteroscedasticity that is indicated by the diagnostic test HETERO (the null hypothesis of constant error variance is rejected at $p<0.01$). The regression residuals are also autocorrelated ($p < 0.08$). No further problems are indicated by the other diagnostic tests although the model explains less of the variation in coffee consumption than it did for cocoa consumption ($R^2=0.83$).

The source of these misspecifications is the sharp fall in coffee consumption in 1977. Figure1 shows the actual and predicted consumption for both coffee and cocoa. The predictions track actual consumption closely, except for coffee consumption in 1977. Frost damage to the 1976 Brazilian crop caused production to fall by 70 percent, reducing world production by 23 percent and causing world exports to fall by 20 percent the following year. With the resulting three-fold increase in real prices the model predicts an eight percent fall in per capita consumption, whereas consumption actually fell by 18 percent Thus the largest regression residual occurs in the period of highest prices and this creates heteroscedasticity. Autocorrelation also results because the 1977 shock influenced future consumption so the regression errors are related to their previous values. These violations of the assumptions regarding the ordinary least squares error term suggest either that the model should be re-specified or that robust estimators should be used.

The problem of autocorrelated residuals was handled by two different methods. The first assumes that the unobservable random errors are truly autocorrelated and uses the generalised least squares estimator. This imposes a transformation on the variables so that the resulting residuals are not autocorrelated. Treating the auto correlation as a second order process, the coefficient estimates for α_1, β_1 and β_2 were 0.40, -0.16 and 0.08. This implies a long-run own-price elasticity of -0.13 (=(-0.16+0.08)/(1-0.40)). The heteroscedasticity of the residuals was not altered by this transformation.

The second method assumes that residuals are autocorrelated because relevant lag lengths are excluded (Hendry and Mizon 1978). Setting lag lengths at *t*-2 ensured that the residuals were not autocorrelated. Four variable/lag length combinations were able to be deleted from this model: Q_{t-1}, P_{t-1}, P_{t-2} and Y_{t-2} (the test of the hypothesis that the coefficients on these terms were jointly zero was not statistically significant, ($F_{(4,17)}=1.10$).

Figure 1. **Actual and predicted developed country consumption levels.**



The resulting model was:

$$Q_t = -0.34Q_{t-2} - 0.17P_t + 1.24Y_t - 0.69Y_{t-1} - 3.41$$

$$(0.16) \quad (0.07) \quad (0.37) \quad (0.35) \quad (0.44)$$

R^2=0.86, $F_{(4,21)}$=31.10, AUTO(1): $F_{(1,20)}$=0.11

ARCH(1): $F_{(1,19)}$=0.51, NORM: $X^2_{(2)}$=0.21

HETERO: $F_{(8,12)}$=3.24, RESET(3): $F_{(2,19)}$=1.27

The standard errors are robust to the heteroscedasticity that is indicated by HETERO. The long-run elasticities are -0.13 and 0.41. Several estimators that directly model heteroscedasticity were used on this specification of the model, included weighted least squares. Only when the heteroscedasticity was modelled as an ARCH(2) process, i.e., the variance of residuals is a function of the residuals lagged twice, did the long-run estimate of the own-price elasticity move from -0.13 (to -0.16). Thus, this data suggests that the world own-price elasticity of demand for coffee is no smaller than -0.13.

This estimate is smaller than those of Akiyama and Duncan (1982) and Islam and Subramanian (1989). One reason is the use of data from the 1980s. Figure 1 shows stable per capita coffee consumption during the early 1980s. In 1986 the real price rose to its second highest level ever but consumption fell only slightly. This was a much less elastic response than in the 1970s and this has influenced the econometric estimates. By 1990 real prices had fallen to one-third of their 1986 level but consumption only increased by 11 percent (from 3.14 to 3.50 kg/person/yr). Hence the elasticity (at the mean of these changes) is -0.11, which suggests that the world elasticity of demand for coffee is falling.

Table 1 shows the calculated values of $(\eta_x)_i$ resulting from Equation (1). Papua New Guinea's small share of world cocoa and coffee exports means that the estimated own-price elasticity is large, despite the small values of $(\eta_x)_w$ resulting from the econometric equations. Assuming perfect price transmission, the short-run, own-price elasticity of demand for cocoa exports is at least -14, and for coffee exports, at least -17. Allowing for imperfect price transmission, the elasticities fall to -11 and -12. Thus, even in the short-run, under conservative assumptions about the transmission of prices and

Table 1. **Estimates of demand for exports of Cocoa and coffee** [1]

Assuming Perfect Price Transmission ($ø_{rji}$ = 1)						
	$(\eta_x)_w$	(X_w/X_i) [2]	(X_r/X_i) [2]	Assumed Value for $(\varepsilon_x)_r$ 0.1	0.3	0.7
Cocoa	-0.21	46.97 [3]	45.97 [3]	-14.46	-23.65	-42.04
Coffee	-0.13	73.48	72.48	- 16.80	-31.30	-60.29
Assuming Imperfect Price Transmission (Producers: $ø_{rji}$ = 0.65, Consumer: $ø_{rji}$ = 0.8)						
Cocoa	-0.21	46.96 [3]	45.97 [3]	-10.88	-16.86	-28.81
Coffee	-0.13	73.48	72.48	-12.35	-21.78	-40.62

Notes: [1]Symbols are defined as for equation (1)
[2]Average of 1989-91
[3]World trade in cocoa beans only

the responsiveness of producers in competing countries, Papua New Guinea has no noticeable market power. Unilateral, one-percent increases in export price would reduce export demand for cocoa and coffee by over ten percent. Allowing more elastic long-run supply responses from competing countries shows even less market power because the estimated elasticities rise to -42 and -60 with perfect price transmission.

DISCUSSION

The price elasticity estimates in Table 1 show that cocoa and coffee exports face an elastic demand curve. This means that Papua New Guinea can safely increase production of cocoa and coffee without fear of causing prices, and export revenues, to fall significantly. Conversely, producers are not able to pass cost increases forward to overseas consumers. Any domestic cost increases resulting from protection for import substitution industries will therefore act as a tax on exporters who pay more for their inputs but receive no increase in the price of their output.

The elastic demand also means that the cocoa and coffee industries can be used as a benchmark for comparing with proposed new industries. There may be some proposed industries which make only a small contribution to increasing employment and incomes for PNG households. It may therefore be more efficient to direct the investment into expansion of cocoa and coffee production, seeing as the elastic demand implies an opportunity for increased exports by competitive producers. For example, if Papua New Guinea had maintained its 1979-81 share of the world cocoa bean market it would now be producing an extra 7800 tonnes of cocoa. This extra production would create a demand for approximately 1.9 million more unskilled labour days. This level of employment generation can be compared with the employment effects of projects directed towards the internal market, such as the cement and tinned fish factories, and rice import substitution. The capital intensity of import-substituting industries and the small size of the internal market put a limit on the number of jobs that can be created.
It may initially seem that the evidence of Papua New Guinea's falling share of world cocoa exports indicates a lack of competitiveness, sug-

gesting that it would be socially unprofitable to expand production. However, much of the lost market share was due to loss of production in North Solomons province following the civil disturbance there. There may have been an additional loss of market share due to falling cost competitiveness, although Papua New Guinea still has comparatively low on-farm production costs because agronomic conditions are better than in competing countries (Simmons 1993). If it is costs beyond cocoa producers' control which cause reduced competitiveness for Papua New Guinea, e.g., higher industrial input costs, higher infrastructure costs, then the essential message of the current paper is supported: the elastic demand facing cocoa and coffee exporters makes them vulnerable to cost increases in the domestic economy because buyers will move to other suppliers if prices are increased.

The estimated elasticities in Table 1 also support the traditional assumption that Papua New Guinea is a price-taker. This has important implications for the current policy of paying subsidies to tree crop producers. For price-taking countries, world markets determine producer prices in the long-run. The subsidies currently being offered have been set on a cost of production basis that has no necessary relation with the world market price (Fleming and Coulter 1992).The artificially high producer prices may discourage producers from taking the necessary steps to improve efficiency and reduce costs. There is some danger that when the subsidies are ultimately removed PNG producers will not be competitive suppliers to the world market.

This problem is exacerbated by the inelastic demand for cocoa and coffee (and the other tree crops) at the world level. The estimated values of $(\eta_x)_w$ are very low but the price elasticity of demand facing individual countries is almost always greater than one. It is therefore sensible for individual countries to use existing world prices to make decisions about the profitability of expanding production. However if all exporters were to simultaneously expand they would be made worse off because the low price elasticity of world demand causes prices to fall. In the absence of effective international agreements the tendency is for oversupply and low prices, due to this conflict between individual and collective action (Islam and Subramanian 1989). Therefore countries who wish to remain involved in cocoa and coffee production need to direct their efforts towards becoming competitive and reliable suppliers. That this can be achieved is illustrated by the experience of Indonesia and Malaysia who increased their share of world cocoa exports from zero and three percent in 1979-81, to five and nine percent in 1989-91.

The estimates in Table 1 also allow an inference to be made about the likely success of devaluation as a policy for improving the balance of payments. The Marshall-Lerner condition, which is a well known proposition in international trade theory, holds that devaluation will make the balance of payments *worse* if the sum of the absolute values of export and import demand elasticities is less than one (Goldstein and Khan 1985). For the 1989-91 period cocoa and coffee accounted for 13 percent of export receipts. Thus, even if the other 87 percent of exports faced absolutely inelastic demand, i.e., $(\eta_x)_i=0$, the weighted average export demand elasticity would be at least -1.53 in the short-run ($(\varepsilon_x)_r=0.1$), and -4.55 in the long-run $(\varepsilon_x)_r=0.7$). Even without knowing what the price elasticity of demand for imports is, this elastic export demand suggests that devaluation could be used if policy makers wished to improve the balance of payments. This is in contrast to the conclusion of Kauzi (1992).

CONCLUSION

The price elasticity of demand for Papua New Guinea exports of cocoa is estimated to be at least -11, and for exports of coffee at least -12. In contrast to some recent analysis and policy decisions, the traditional assumption of Papua New Guinea being a price-taking country is supported. Expansion of production will not influence the prices received for exports. If import substitution industries are given protection and this causes increased prices, cocoa and coffee exporters will suffer reduced incomes because they have no power to pass costs forward to foreign consumers. Subsidies for tree crop producers help improve incomes but have the potential to create a high-cost, inefficient industry that will not survive intense competition on the world market.

REFERENCES

AKIYAMA, T. and DUNCAN, R. (1982). Analysis of the world coffee market. *World Bank Staff Commodity Working Paper*, No. 7.

ASKARI, H. and CUMMINGS, J. (1977). Estimating agricultural supply response with the Nerlove model: a survey. *International Economic Review* 18(2): 257-292.

BEHRMAN, J. (1968). Monopolistic cocoa pricing. *American Journal of Agricultural Economics* 50(3): 702-719.

BLOMQVIST, A. and HAESSEL, W. (1972). The price elasticity of demand for Ghana's cocoa: some estimates and policy implications. *Economic Bulletin of Ghana* 2(3): 15-29.

BREDAHL, M., MEYERS, W. and COLINS, K. (1979). The elasticity of foreign demand for U.S. agricultural products: the importance of the price transmission elasticity. *American Journal of Agricultural Economics* 61(1): 58-63.

CHIAO, Y-S. and SCOBIE, G.M. (1989). The cost to agriculture of import protection in New Zealand. *Proceedings Australian Agricultural Economics Society Conference*, Lincoln University, New Zealand.

CLEMENTS, K.W. and SJAASTAD, L. (1984). How protection taxes exporters. *Thames Essay*, 39, Trade Policy Research Centre, London.

CRONIN, M. (1979). Export demand elasticities with less than perfect markets. *Australian Journal of Agricultural Economics* 23(1): 69-72.

FLEMING, E. and COULTER, H. (1992). The future role of marketing authorities in the South Pacific. *Agricultural Export Marketing in the South Pacific* Ed. E. Fleming and H Coulter. National Centre for Development Studies, Australian National University, Canberra. pp.1-9.

FOOD AND AGRICULTURE ORGANISATION OF THE UNITED NATIONS. (1992). *AGROSTAT*.PC, FAO Statistics Division, FAO, Rome.

GARDINER, W. and CARTER, C. (1988). Issues associated with elasticities in international agricultural trade. *Elasticities in International Agricultural Trade* Ed. W. Gardiner and C. Carter. Westview Press, Boulder, CO. pp.1-16.

GIBSON, J. (1992). "Rice self-sufficiency and the terms of trade: Why rice is a good thing to import", *Policy Working Paper* No. 2, Programming, Planning and Budgeting Division, Department of Agriculture and Livestock, Papua New Guinea.

GIMBOL, C. (1992). Cocoa stabilisation in Papua New Guinea: approaches and issues. *Agricultural Export Marketing in the South Pacific* Ed. E. Fleming and H Coulter. National Centre for Development Studies, Australian National University, Canberra. pp.189-200.

GOLDSTEIN, M. and KHAN, M. (1985). Income and price effects in foreign trade. *Handbook of International Economics* Ed. R. Jones and P. Kenen. North-Holland. pp.1041-1105.

HENDRY, D. (1989). *PC-GIVE: An Interactive Econometric Modelling System*, Institute of Economics and Statistics: Oxford University.

HENDRY, D. and MIZON, G. (1978). Serial correlation as a convenient simplification, not a nuisance: A comment on a study of the demand for money by the Bank of England. *The Economic Journal* 88(4): 549-563.

HORNER, F. (1952). Elasticity of demand for the exports of a single country. *Review of Economics and Statistics* 34(3): 326-342.

ISLAM, N. and SUBRAMANIAN, A. (1989). Agricultural exports of developing countries: estimates of income and price elasticities of demand and supply. *Journal of Agricultural Economics* 40(2): 221-231.

JOHNSON, P. (1970). Balance of payments 'pressure': the Colombian case. *Southern Economic Journal* 37(2): 163-73.

KAUZI, G. (1992). The pros and cons of devaluation. *Business Times* (23.4.92), Port Moresby, Papua New Guinea.

LAM, N.V. (1979). Incidence of agricultural export taxation in Papua New Guinea. *Journal of Development Studies* 15(2): 177-193.

MUNDLAK, Y. and LARSON, D. (1992). On the transmission of world agricultural prices. *The World Bank Economic Review* 6(3): 399-422.

SCOBIE, G. (1973). The price elasticity of demand for New Zealand exports: theory and estimation. *New Zealand Economic Papers* 7(1): 1-24.

SIMMONS, R. (1993). Competitiveness in the agriculture sector. *Paper presented at the INA/NRI seminar, Employment, Agriculture and Industrialisation*, Port Moresby.

SINGH, S. and de VRIES J. (1977). Coffee, tea and cocoa. Market Prospects and development lending. *World Bank Staff Occasional Papers*, No. 22.

SUMMERS, R. and HESTON, A. (1991). The Penn World Table (Mark 5): An expanded set of international comparisons, 1950-1988. *Quarterly Journal of Economics* 106(2): 327-362.

UNCTAD (1974). Survey of commodity demand and supply elasticities. UNCTAD Research Division, *Research Memorandum* No. 48.

WHITE, H. (1980). A heteroscedasticity-consistent covariance matrix estimator and a direct test for heteroscedasticity. *Econometrica* 48(4): 817-838.

YEBOAH, D. 1991, "Forecasting Coffee Consumption With a Flexible Consumer Demand Function." *UNCTAD Review* No. 3.