

THE RELATIONSHIP BETWEEN COMMODITY PRICES AND OUTPUT/EXPORTS

Seema Narayan

Working Paper

2000/07

November 2000

Economics Department

Reserve Bank of Fiji

Suva

Fiji

The author is indebted to Mr Steven Morling and Mrs Annie Rogers for their useful comments on this paper. The views expressed in the paper are those of the author and do not necessarily reflect those of the Reserve Bank of Fiji.

Abstract

Primary commodities are important exports for Fiji, contributing around 60 to 65 percent to total export receipts. Prices of primary commodities have been very unstable, subject to both secular and temporary fluctuations, which in turn, has given rise to unevenness in the value of export earnings and reserve levels.

To date, there has not been any empirical evidence on the influence of commodity prices on Fiji's output or the volume of exports. While some studies have analysed the determinants of output and trade in Fiji (see for example, Williams and Morling, 2000; Prasad, 2000; and Rogers, 2000), none have focused on the relationship between commodity prices and trade or output.

This paper takes an econometric approach towards bridging this gap by attempting to explain relationships between primary commodity prices and output/exports in Fiji via an output fluctuation model developed by Williams and Morling (2000) and an export model derived in the paper. The paper finds that primary commodity prices significantly affect real output in the short term. A one percent decline in commodity prices, for instance, leads to a 0.05 percent decline in real output.

The findings further reveal that a ten percent fall in commodity prices results in a four percent fall in real exports in the short run. The results show that while the relationship between commodity prices and total output/exports is statistically significant, the responsiveness of these relationships are relatively inelastic.

1.0 Introduction

Primary commodities play a significant role in Fiji's trade with the rest of the world, as it constitutes a major proportion of our foreign exchange export earnings. Their importance stems not only from this role but also as an important source of employment and income of the people involved.

Prices of primary commodities have been very volatile, subject to both secular and temporary fluctuations. A number of empirical studies, (see for example, Grilli and Yang, 1988; Cuddington and Urzua, 1989; Cuddington, 1992; and Greenaway and Bleaney, 1993), have concentrated on the statistical analysis of long term movements in relative prices of primary commodities. Some studies point to the presence of a downward trend, while others argue that prices have been subject to one or more structural breaks in which prices were permanently lower following the break(s). The finding one obtains on long-run trends of primary commodities depend significantly on the time period selected and the commodity bundle concerned. Hence, while there is some tendency for a decline in commodity prices, it is far from clear that this is true for all commodities, or that the decline takes the form of a smooth trend rather than a succession of downward jumps. However there is a general agreement that (real and nominal) prices of primary commodities are generally volatile.

The literature also suggests that most primary commodity-producing economies do not have a co-ordinated supply response to changes in prices. This is due to numerous factors which include delays in recognition,

decision and delivery (see, among others, Lawrence, 1990; United Nations, 1987; Rodgers, 1998).

It has been frequently pointed out that apart from these problems, Fiji faces other serious constraints¹ (such as land tenure problems and lack of technology, finance, and expertise) which may reduce producers' capability to adjust production in response to price changes. These trigger the question of whether Fiji's commodity supplies respond to price changes or not.

The paper aims to provide a clear understanding of the relationship of commodity prices with output/exports in Fiji. The paper is divided into three major sections. Section one highlights the major trends in prices and production of Fiji's five major commodity exports. Section two examines the relationship between commodity prices and output. This is analysed via an output fluctuation model developed by Williams and Morling (2000). Section three provides empirical analysis on price elasticities using an export supply function, following Ridler and Yandle (1972). The final section highlights the various policies, which could be implemented to respond to negative commodity price shocks.

¹ Refer to Forsyth (1996), Chand (1998), and Barbour and McGregor (1998).

2.0 Major Trends in Commodity Prices and Production

2.1 Sugar

2.1.1 Price

More than half of Fiji's sugar is traded under preferential arrangements to markets such as the European Union (EU) (under the Lome agreement²), Portugal and Finland (via the Special Preferential System) and the US market (through a quota allocation). Preferential sugar prices are well above world market (WM) prices and remain fixed for a certain number of years before being revised. Subsidised EU prices, for instance, are currently around 3 times higher than the WM price and in real terms, have remained quite stable throughout the 1966-99 period.

World market sugar prices, on the other hand, have been very volatile. This is largely due to a variety of protective and subsidy measures in industrialised countries which shift the burden of adjustment to changes in demand or supply to the small residual free market for sugar. Since only about one fifth of global annual production³ is traded freely in the international market, even a moderate production swing can have a pronounced market impact.

While real world market sugar prices averaged around 25 cents per pound during 1966-1979 period, they fell to an average of around 15 cents a pound in the following two decades. Among the major factors behind

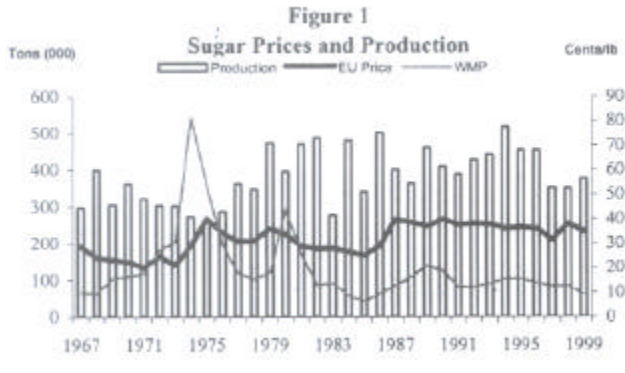
² The Sugar Protocol replaced the Commonwealth Sugar Agreement (CSA) of 1950. The CSA was a preferential agreement between the UK and the Commonwealth countries by which the UK guaranteed to purchase specified quantities of sugar at a negotiated price. The Sugar Protocol between the EU and the ACP countries came into force in 1975 and was enshrined in Protocol 3 of the Lome Convention.

recent declines in sugar prices are excess supply in the market, which is subject to a significant degree of policy intervention concerning conditions of production and consumption.

2.1.2 Production

Fiji's sugar production roughly averaged around 310,000 tonnes per year during the 1960s and 70s to around 415,000 in the 1980s and 90s. The Sugar industry in Fiji faces a number of constraints, some of which have remained in the industry for decades. Problems, such as land tenure; low sugar content due to cane burning, strikes by farmers or mill workers, and depressed world market sugar prices, have all acted as constraints to higher growth in the sugar industry. Heavy reliance on preferential arrangements and Fiji's non-competitive position in the world market, (due to a higher cost structure and poor quality sugar compared to that of competitors), provide no added incentive to produce more.

³ World Commodity Profile – Food, Feedstuffs & Beverages, 1998-99.



2.2 Gold

2.2.1 Price

Gold has long been a store of value and is regarded as a good investment in times of high inflation. In periods of low inflation, gold is generally abandoned in favour of other investments which produce better returns. With the current combination of generally low inflation and high growth in most major global economies, gold prices have declined considerably, with prices reaching a 20-year low in August 1999. Gold sales by many central banks have pulled prices down even further in recent years. Real prices have fallen by more than 24 percent in the last twelve years, after reaching an all time high in 1987.

2.2.2 Production

The Emperor Gold Mines Company Ltd (EGM) has largely controlled gold production in Fiji, since the discovery of gold in Vatukoula

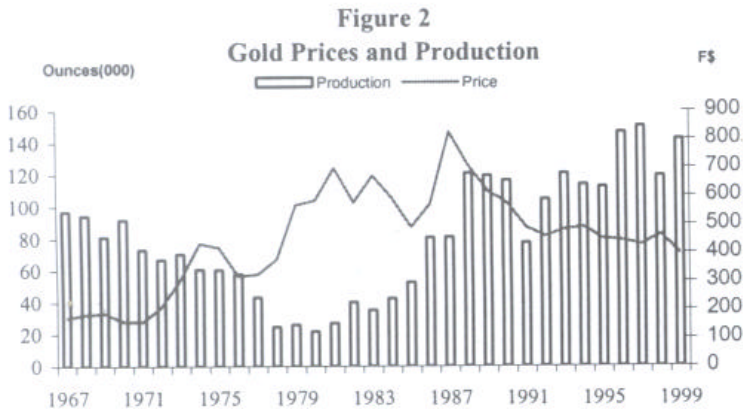
in 1932.⁴ In 1996, the Mt Kasi Mines were commissioned but went out of operation in 1998 after experiencing financial difficulties.⁵ During the 1996-97 period, the Mt Kasi Mines produced around 13 percent of total gold production.

One of the most important factors affecting gold production is unfavourable gold prices in world bullion markets. EGM has been a minimally hedged company, therefore, production and profitability is highly levered to movements in gold prices. Prolonged strikes by workers have also affected gold production; in 1991 a major labour strike lasted for almost a year. Accidents are also a serious problem for the industry. The higher the number, and the more fatal the accidents, the higher the losses in terms of time and thus production.

Although the mining industry is labour intensive, substantial capital investment is required for greater operational efficiencies. Huge investment in capital upgrades by EGM in the early 1990's, has been the major reason for the rise in gold output in later years. For instance, during the 1990's production levels were generally higher than in previous decades. The capital expansion has reduced costs and facilitated production increases. To some extent this explains the survival of EMG during the 1990s, when gold prices were lower than the previous decade.

⁴Since 1932, Emperor Gold Mines Co. Ltd. has yielded more than six million ounces of gold from 19 million tonnes of ore.

⁵Source: Fiji Times (10/10/99)



2.3 Fish

2.3.1 Price

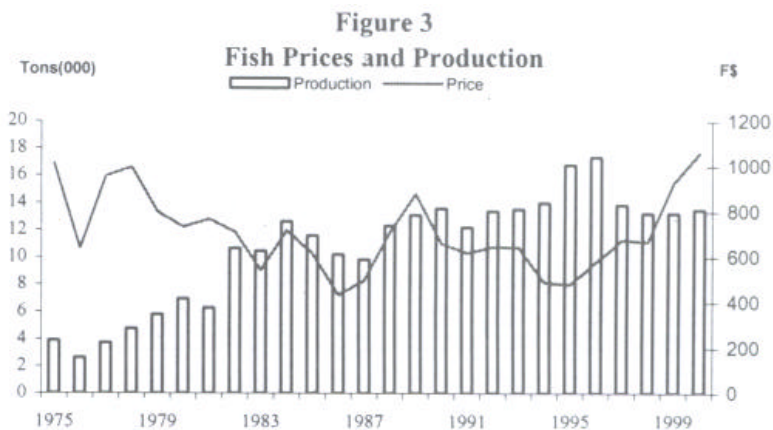
Like other commodity prices, movements in fish prices have generally depended on demand and supply. For world market fish prices the best available indicator is fishmeal prices. In real terms, prices of fishmeal have risen by an average of 3 percent per year. Prices of fishmeal have generally been around \$740 per tonne, with only a few outliers in the early years. The lower prices in the early 1980s and 1990s, was largely due to oversupplies in the fish market, while intense competition and uncertainty over the supply of raw fish generally led to price rebounds in the late 1980s and 1990s.

2.3.2 Production

While fish production largely depends on catches by both foreign and local boats, production figures in this paper only take into account the

local boat catches component, since data on catches by foreign boats for the period 1966-1998 are not available. Fiji sells both frozen and canned tuna in the international market. Lately, export of fresh fish has also gained importance, especially to the US and Japanese markets.

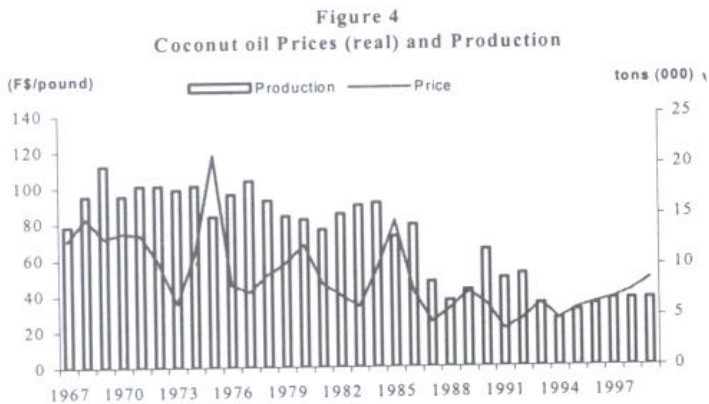
Fish production has changed marginally over the last two decades (see Figure 3). While prices may have affected production, (although not visibly apparent in Figure 3), a more important factor affecting fish production in Fiji is the low volumes of fish catches, largely as a result of a lack of proper facilities and climatic changes. Also affecting the industry, especially tuna cannery operations, is fierce competition from other canned tuna producers such as the Ivory Coast, Senegal, Philippines, Thailand and Indonesia. The survival of the tuna industry in Fiji is heavily dependent on preferential tariffs granted by the European Union via the Lome agreement.



2.4 Coconut Oil and Timber

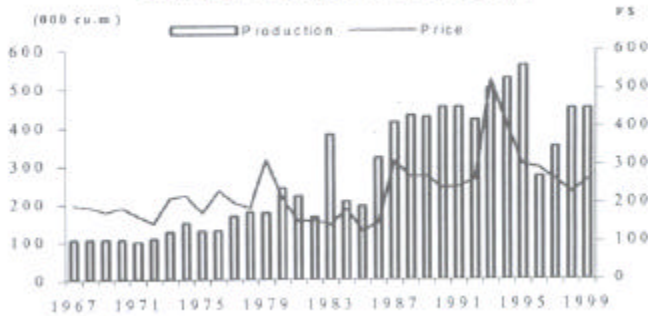
2.4.1 Prices and Production

Production of coconut oil and timber are subject to relatively pronounced price instability. This is largely due to a delayed supply response through price-induced investments largely owing to a long gestation period before commercial production.



Changes in the prices of substitutes also affect the demand for coconut oil. The major substitutes for coconut oil are soybean, sunflower, rapeseed, palm, and palm kernel oils. Hurricanes and cyclones, as well as other mishaps such as fires are amongst the major factors affecting the production of timber.

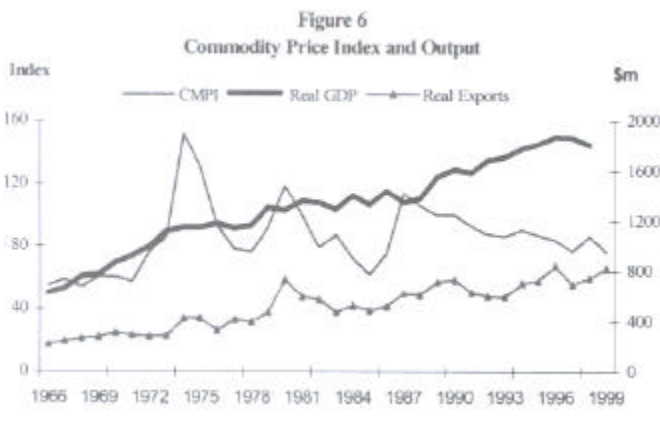
Figure 5
Timber Prices and Production



2.5 Commodity Price Index, Output and Exports

For the purpose of analysing the relationship between commodity prices and output/exports, an index of commodity prices is constructed. The commodity price index (CMPI) (in real terms) was calculated as an index of the world market prices (in real terms) of Fiji's major export commodities, namely, sugar, gold, fish, timber and coconut oil (in Fiji dollars), weighted by their respective export share.

The CMPI was generally volatile throughout the review period but showed a distinctly downward trend after 1987, mainly due to a supply glut in the world market of mainly sugar and gold. An economic slowdown in most economies (especially the Asian and a few Latin American countries) depressed prices further during the 1990's, as demand for these goods fell.



There is hardly any close correspondence between output and the commodity price index throughout the review period (figure 6). However the movements in exports and the commodity price index were closely related during most of the review period, whereby an increase in prices also saw a rise in exports in almost the same year. Since the late 1980's, this pattern has been disturbed such that exports have continued to rise amid a steady decline in commodity prices. Part of this could be explained by the fact that some of the industries, which were not significant during the late 1980's, became important contributors to export earnings in the 1990's. The Textile, Footwear and Clothing (TFC) industry, for instance, became a significant export earner in the 1990's contributing on average around 25 percent to total exports compared to its average contribution of around 2 percent in the 1980's. Furthermore, it is also apparent from the previous charts (figures 2-5) that exporters increased production as a way to combat falling prices for their products.

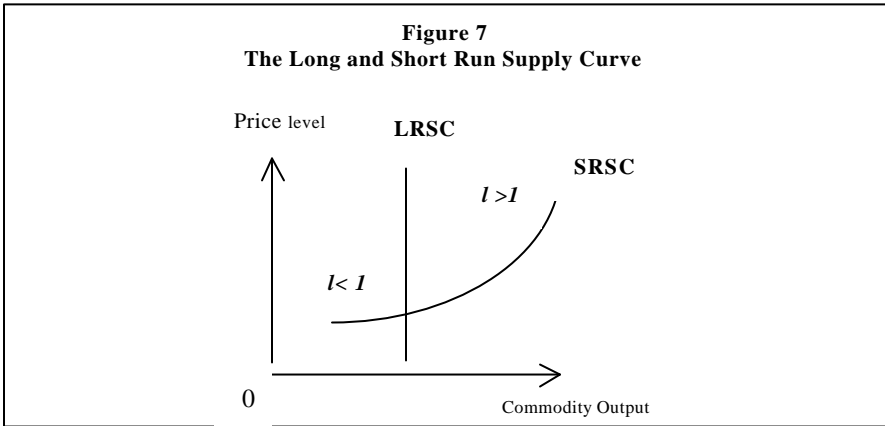
3.0 Price Elasticities of Supply and the Supply Function in the Short and Long run

The key interest in this paper is whether or not there is a relationship between output supplied and prices, that is, the price elasticity of supply. Price elasticity of supply is the measure used to determine the degree of responsiveness of output to changes in prices. The price elasticity of supply generally rises (slope of the supply curve steepens) as the degree of resource utilisation rises.

In the short run the supply curve (SRSC) is upward sloped – a rise in prices results in an increase in supply, *ceteris paribus*. However, in the long run, input prices adjust to ensure full employment of resources, thus the quantity of real output supplied is independent of the price level. Hence, the conventional long run supply curve (LRSC) is vertical.

Fiji is a small island country but many of its resources are still untouched or under-utilised - these include both land and sea resources. Given that Fiji has a long way to go before reaching full employment, prices are likely to affect output, and since the degree of resource utilisation is low, the price elasticity is also expected to be low. This concept of the price elasticity forms the basis for the methodology used in later sections.

Figure 7
The Long and Short Run Supply Curve



4.0 Effect of Commodity Prices on Output

The five major commodities analysed in the paper make up roughly 65 percent of Fiji's total commodity output – with sugar holding the largest share. Prices of these commodities have fluctuated considerably during the years under study, with sudden and short booms alternating with long periods of stagnation and declines⁶. Production, on the other hand, has remained reasonably stable for some commodities (for example, sugar) but has fluctuated significantly for other commodities in the review period.

The question addressed in this section is whether, and to what extent, Fiji's output has responded to fluctuations in commodity prices. In order to facilitate this an output model developed by Williams and Morling (2000) is used.

⁶ However, it is important to note that prices of different commodities do not move in parallel. Although fluctuations in world demand impart common components to many price series, supply conditions differ across goods and relative prices are far from constant.

4.1 The Model

The model used in the paper is adopted from Williams and Morling (1999)⁷ which has the same theoretical underpinnings as the model developed by Gruen and Shuetrim (1994). The general form of the Williams and Morling model is:

$$\Delta y_t = b_0 + \sum_{i=1}^m b_i \Delta y_{t-i} + \sum_{i=0}^m b_2 \Delta y^*_{t-i} + \sum_{i=1}^n b_3 r_{t-i} + b_5 S_t + c_1 y_{t-1} + c_2 y^*_{t-1} + \mathbf{u}_t \quad (1)$$

where y and y^* are the logarithms of Fiji and foreign GDP, r is the real short-term interest rate, and S is an agricultural supply-side variable.

With the main aim being to examine the relationship between commodity prices and output, the real commodity price index (cmpi) in logarithmic form, was included in equation (1). Insignificant variables were sequentially deleted to arrive at the preferred specification shown below:

$$\Delta y_t = b_0 + \sum_{i=0}^m b_2 \Delta y^*_{t-i} + \sum_{i=1}^n b_3 r_{t-i} + \sum_{i=0}^q b_4 \Delta \text{cmpi}_{t-i} + b_5 S_t + c_1 y_{t-1} + c_2 y^*_{t-1} + \mathbf{u}_t \quad (2)$$

The model uses an index⁸ of real prices of the five commodities rather than individual commodity prices. While a disaggregated study of commodity prices would have been ideal, this strategy could not be

⁷ Refer to Williams and Morling (2000) for further information on the methodology and estimation of the model.

⁸ Deaton (1999) and Deaton and Miller (1995) also used indexes of commodity prices for similar analysis.

implemented econometrically due to the presence of highly correlated prices in the equation – the usual multicollinearity problem.⁹

4.2 Data

Time series data from 1965 to 1999 are used. The main sources of the data are the IMF International Financial Statistics and various issues of the Bureau of Statistics' Current Economic Statistics (see Appendix). Some of the series were constructed from primary data - methods of construction are also detailed in the Appendix. The Standard Augmented Dickey-Fuller test (Said and Dickey 1984) and the Phillips and Perron test (1998) were used to carry out preliminary tests to examine the time series properties of the data. These tests allow for a unit root null hypothesis to be tested against a stationary alternative. The supply shock term, real GDP and the real commodity price index appear to be $I(0)$. The real interest rate and income of trading partner countries appear to be integrated of order 1.

⁹ Multicollinearity among the variables does not pose any threat to the results of the model but gives few significant *t-ratios* and possibly a high R^2 .

Table 1: Unit Root Tests

Variables	Estimation period: 1966 – 1998			
	Dickey-Fuller Test		Phillips-Perron Test	
	I(1)	I(2)	I(1)	I(2)
Real GDP	-3.306*	-3.624*	-3.373*	-5.967**
Trading partner output	-3.388	-3.418**	-2.683*	-4.557**
Agricultural shocks	-3.559*	-5.381**	-6.402**	-12.441**
Real interest rate	-2.907	-4.045*	-2.978	-6.277**
Commodity Price Index	-3.206*		-2.673	-4.756**

Notes: **(*) indicates significance at the one (five) percent level. The critical values for the Augmented Dickey-Fuller tests are -2.640 and -1.953 at the one and five percent levels, respectively. The critical values for the Phillips-Perron tests are -2.640 and -1.953 at the one and five percent levels, respectively.

4.3 Diagnostics

The model was tested for normality, serial correlation, autoregressive conditional heteroskedasticity, heteroskedasticity, specification error and stability. The results, reported in Table 2, suggest the model is well specified. The diagnostics indicate that the residuals are normally distributed, homoskedastic and serially uncorrelated and the parameters appear to be stable.

Table 2: Diagnostic for output model

			Probability
Normality			
Jarque-Bera statistic	X ² -statistic	0.935	0.626
Serial Correlation:			
Breusch-Godfrey Serial	F-statistic	0.319	0.730
Correlation LM Test	X ² -statistic	0.862	0.650
AR Cond. Heteroskedasticity			
ARCH LM Test	F-statistic	1.120	0.298
	X ² -statistic	0.1.156	0.282
Heteroskedasticity:			
White Heteroskedasticity	F-statistic	0.275	0.987
Test			
	X ² -statistic	4.748	0.966
Stability:			
Chow Breakeven Test (mid-sample)	F-statistic	0.329	0.930
	L-R statistic	3.860	0.796
Chow Forecast Test (1990-1998)	F-statistic	0.728	0.679
	L-R statistic	10.982	0.277
Specification Error:			
Ramsey RESET Test	F-statistic	0.416	0.525
	L-R statistic	0.550	0.458

Notes:**(*) denotes significance at the one (five) percent levels. No terms were significant at these levels. LR is a likelihood ratio statistic.

4.4 Results

The results of estimating equation 1 are reported in Table 3. As expected, the estimated co-efficient for commodity prices is positive and suggests that a ten percent decline in commodity prices leads to a fifty basis points decline in Fiji's output. The parameter for export commodity prices in the short run suggests Fiji's output reacts significantly to prices, albeit slowly. An inelastic supply response to price changes is largely due to a long gestation period for most agricultural commodities. Hence, adjusting the primary commodity supply level, or switching from one commodity to another, is virtually impossible in the short run.

Deaton (1999) and Deaton and Miller (1995) carried out a similar analysis. Deaton (1999) regressed the growth of per capita GDP of Africa on the growth of the commodity price index and its lags, without allowing for other determinants of growth in Africa in his regression equation. The total price co-efficient (lagged 0 to -3) was around 0.15 in the short run. Deaton and Miller (1995) used vector autoregressions supplemented by price indexes to examine the relationship between prices and output in Africa. Their commodity price elasticity was smaller than that of Deaton (1999).

Table 3: Impact of Commodity Prices on Output

Dependent variable: $\Delta \log \text{GDP}$; estimation period 1966 – 1998

Explanatory variables:	(1)	
Constant	-0.038 (-0.2815)	
Agricultural supply-side shocks _t	0.220 (8.065)**	
Δ Trading partner GDP _t	0.999 (5.174)**	
Real Short-term Interest Rate _{t-1}	-0.005 (-5.648)**	
D Commodity Price Index_t	0.045 (2.053)*	
GDP _{t-1}	-0.316 (-7.389)	
Trading partner GDP _{t-1}	0.325 (6.378)**	1.028 (15.892)**
Summary Statistic:		
Adjusted R ²	0.772	
σ	0.025	

Note: t -values are in parentheses. **(*) Denotes significance at the one (five) percent levels.

5.0 Commodity Price Elasticities and Exports

The previous section broadly examined the relationship between commodity prices and output, and indicated that there is a significant and positive short-term relationship between output and commodity prices. This section takes a more direct approach - studying the relationship between exports and prices. An export function is derived to investigate whether there is any significant relationship between commodity prices and exports.

5.1 The Model

The export model used in this section attempts to identify the relationship between prices and exports. For the purpose of analysing the export/price relationship, it is assumed that adjustments in exports arise as a

result of changes in world equilibrium prices of primary commodities. Changes in world market prices incorporate global demand and supply responses from all exporters, including Fiji.

The methodology is adopted from Ridler and Yandle (1972), who presented a simple method to take account of exchange rate changes as they may affect the export earnings of a single country from a primary commodity. In the Ridler and Yandle (1972) model, a change in exports (rx_t) (in terms of the exporter's currency) in response to a price change is:

$$\Delta rx_t = b_l \Delta P_t \quad (3)$$

where $\Delta P_t = \Delta p^*_t - \Delta r_t \quad (4)$

where b_l is the price elasticity of the country's export supply of a commodity; r is the country's exchange rate against the importer's currency; p^* is the world market price of a commodity in terms of the exporter's currency and P is the world market price of a commodity less the percentage change in the country's exchange rate against the importer's currency.

Since the analysis includes five major export commodities, their prices are aggregated as an index series and included in the model as the variable, *cmpi* (commodity price index). Replacing $\Delta p^*_t - \Delta r_t$ with $\Delta cmpi$ and allowing for the possibility of lags, gives:

$$\Delta rx_t = \sum_{i=0}^l \mathbf{S} \mathbf{b}_i \Delta cmpi_{t-i} \quad (5)$$

Equation (5) is nested in a broader export function (6) which also included trading partner demand (y^*) and a supply shock-term (Z):

$$\Delta rx_t = \mathbf{a}_0 + \sum_{i=0}^l \mathbf{S} \mathbf{b}_i \Delta cmpi_{t-i} + \sum_{i=1}^m \mathbf{S} \mathbf{j}_i \Delta rx_{t-i} + \sum_{i=0}^n \mathbf{S} \mathbf{f}_i S_{t-i} + \sum_{i=0}^o \mathbf{S} \mathbf{l}_i \Delta y^*_{t-i} + c_1 cmpi_{t-1} + c_2 rx_{t-1} + v_t \quad (6)$$

Equation 6 describes a country's supply of a group of countries' demand for imports (real exports = rx), which is hypothesised to depend on three variables: (real) commodity price index ($cmpi$); the sum of real GDP of trading partner countries (y^*); and a supply shock term (z). \mathbf{a}_0 is the constant term; $b_i, \mathbf{j}_i, \mathbf{f}_i$ and \mathbf{l}_i are coefficients of the short run independent variables; c_i is the co-efficient of the long run independent variables; and v is the error term.

The real income of trading partner countries and the supply shock¹⁰ term explain the non-commodity price effects on exports. A rise in the income of trading partners should boost export supplies, since a rise in incomes in trading partner countries would likely increase their demand for imports (refer to Bond, 1985; Senhadji and Montenegro, 1998; and Prasad 2000). The supply shock term, S_t captures an array of observed shocks in

¹⁰ Refer to Williams and Morling (2000) and Prasad (2000) for further explanations on these two variables.

the export sector, and is represented by sugar productivity for the 1966-98 period.

5.2 Data

Most of the data series are adopted from the previous section while the sources for the new series are mainly the IMF International Financial Statistics or the Bureau of Statistics' Current Economic Statistics (refer to the Appendix for the derivation of the price index). The variables in the export model were tested for the presence of a unit root. The unit-root hypothesis was tested using the standard Augmented Dickey-Fuller (ADF) test (Said and Dickey (1984) and the Phillips and Perron test (1998)). Empirically, real exports, total commodity prices and trading partners' GDP appear to be integrated of order 1, while sugar production appears to be I(0). Accordingly, each series is treated as I(1), with the exception of sugar production.

Table 4: Unit Root Tests				
Variables	Dickey-Fuller Test		Phillips-Perron Test	
	I(1)	I(2)	I(1)	I(2)
Real Exports	-1.879	-4.525**	-2.027	-6.070**
Sugar Production	-2.885*		-5.482**	
Trading Partner GDP	0.5138	-3.732**	-0.500	-4.638**
Commodity prices index	-3.206*		-2.673	-4.756**

Notes: **(*) indicates significance at the one (five) percent level. The critical values for the Augmented Dickey-Fuller tests are -3.658 and -2.959 at the one and five percent levels, respectively. The critical values for the Phillips-Perron tests are -3.658 and -2.959 at the one and five percent levels, respectively.

5.3 Estimation

The export model is estimated over the period 1966 to 1998. The long-term equilibrium relationship and short-term fluctuations are determined simultaneously, thus equation (1) is a representation of an error correction model (ECM). This approach is recommended over the two-step Engle-Granger procedure, particularly for finite samples, where ignoring dynamics when estimating the long-run parameters can lead to substantial bias.¹¹

This specification has the advantage of isolating the speed of adjustment parameter, c_2 , indicating how rapidly the system returns to equilibrium after a random shock. The significance of the error correction

¹¹ Banerjee et al. (1993) and Inder (1994) show that substantial biases in static OLS estimates of the cointegration parameters can exist, particularly in finite samples, and that unrestricted error correction models can produce superior estimates of the cointegrating vector.

coefficient is also a test for cointegration (see for instance Kremers, Ericsson and Dolado, 1992). Another reparameterisation, the Bewley (1979) transformation, isolates the long-run or equilibrium parameters and provides t-statistics on those parameters. Inder (1991) shows these approximately normally distributed t-statistics are less biased than the Phillips-Hansen adjusted t-statistics.

5.4 Diagnostics

The statistical properties of the model were also tested. The model was tested for normality, serial correlation, autoregressive conditional heteroskedasticity, heteroskedasticity, specification error and stability.

The results, reported in Table 5, suggest the model is well specified. The diagnostics indicate that the residuals are normally distributed, homoskedastic and serially uncorrelated and the parameters appear to be stable.

Table 5: Diagnostics for the Export Model

			Probability
Normality			
Jarque-Bera statistic	X ² -statistic	2.362	0.307
Serial Correlation:			
Breusch-Godfrey Serial	F-statistic	0.507	0.608
Correlation LM Test	X ² -statistic	1.287	0.526
AR Cond. Heteroskedasticity			
ARCH LM Test	F-statistic	0.117	0.735
	X ² -statistic	0.124	0.725
Heteroskedasticity:			
White Heteroskedasticity Test	F-statistic	0.681	0.730
	X ² -statistic	7.803	0.648
Stability:			
Chow Breakeven Test (mid-sample)	F-statistic	2.793	0.037
	L-R statistic	19.360	0.004
Chow Forecast Test (1990-1998)	F-statistic	0.525	0.849
	L-R statistic	8.887	0.543
Specification Error:			
Ramsey RESET Test	F-statistic	0.013	0.911
	L-R statistic	0.016	0.899

Notes:**(*) denotes significance at the one (five) percent levels. No terms were significant at these levels. LR is a likelihood ratio statistic.

5.5 Results

The results¹² in Table 6 show the correct signs for the price elasticity of supply. As expected, the estimated coefficient on real commodity prices in the short run is positive and suggests that a one percent decline in the prices of the five commodities leads to a decline of around 0.44 percent in Fiji's exports. This finding is in line with Rodgers' (1998), and Lords' (1991) findings which showed similar export-supply price coefficients and revealed that primary commodities are typically inelastic in the short run. Greenaway and Bleaney (1993) examined the relationship between the relative prices of primary commodities and the terms of trade. Their results also showed a similar relationship but smaller results (since the terms of trade takes into account both export and import prices).

In the long run, the price elasticity of supply is similar to the short-run price elasticity of supply. A one percent increase in the commodity price index, for instance, results in a 0.4 percent rise in export earnings.

The literature points out that the short-term price elasticities are generally smaller than in the long run for most primary commodity-producing economies. This is largely because they do not have a coordinated supply response to changes in prices. Adjustment costs and incomplete information usually delay consumers' and firms' responsiveness to price changes, which also leads to an imbalance between supply and demand.

¹² Prasad (2000) devised a similar export model, without price variables but incorporated all the other variables treated as controls in the paper. The results on the non-price variables are similar in both papers.

Junz and Rhomberg (1973) discuss a number of lag types, including delays in recognition, decision, delivery, the replacement of inventory and equipment and in the production of additional output, which affect exporters' response to changes in prices. Natural growing constraints for primary commodities can further delay any export supply response. Lawrence (1990) provided a theoretical basis for incorporating production lags into an export supply model. The model's essential implication was that export supply exhibits smaller elasticities in the short run than in the long run.

However, in Fiji's case, the contemporaneous long-term effect of commodity price changes is zero. Production constraints, such as land tenure problems (uncertainty over land ownership/rights and renewal of land leases), lack of technology and expertise and dependence on trade agreements for major commodity exports reduce producers' capability to adjust the rate of production according to price changes in the long run.

Table 6: Impact of Commodity Prices on Real Exports

Dependent variable: $d \log$ Real Exports; estimation period 1966 – 1998		
Explanatory Variables: Short Term	(1)	(2)
Constant	-1.118 (-2.365)*	
Δ Commodity Price Index $_{t-1}$	0.440 (3.860)**	
Sugar Production	0.008 (3.017)**	
Explanatory Variables: Long Term		
Real Exports	-0.546 (-3.666)**	
Commodity Price Index	0.236 (2.428)*	0.435 (2.598)*
Trading Partner GDP	0.696 (3.533)**	1.274 (9.075)**
Summary Statistic:		
Adjusted R ²	0.562	
σ	0.102	

Note: t-values are in parentheses. **(*) denotes significance at the one(five) percent levels.

6.0 Policy Issues

Primary products account for more than half of Fiji's export earnings with the bulk of export earnings derived from only one or two commodities. Being only a small open economy, Fiji has no control over world commodity prices. Yet, fluctuations in long-term trends and short-term prices have important consequences on the economy's terms of trade, reserves levels and the ability to service debt. Fluctuations in prices in countries already experiencing significant external imbalances can trigger a currency, banking or debt crisis.

In order to protect themselves from adverse external price shocks most countries use self-insurance. They hold reserves and commodity stabilisation funds, arrange emergency lines of credit, enter co-operative arrangements with other countries and control domestic demand. They also target supply-side reforms to reduce vulnerability to external shocks. Structural reforms, for instance, help to diversify exports, improve productivity and competitiveness and make the economy generally more flexible in the longer term.

The appropriate policy response to a commodity price shock depends mainly on whether the shock is perceived to be temporary or permanent (Reinhart and Wickham, 1994; Cuddington and Urza, 1989; and Deaton, 1992). The longer it takes for a price shock to reverse itself, the less likely it is that price stabilisation schemes will be viable (Cashin, *et. al.* 1999). Hence, policymakers need reliable estimates of the magnitude and duration of commodity price shocks, when considering countercyclical stabilisation policies (Cashin, *et.al.* 1999). It is also crucial to correctly interpret market developments in order to apply the appropriate policy response (Reinhart and Wickham, 1994).

Reinhart and Wickham, (1994) argue that while commodity prices are volatile, in recent years commodity-exporting countries have also faced a downward trend in real commodity prices. In such cases, policies based on the assumption that the weakness in real commodity prices will be quickly overcome may be proven wrong as some supply-side factors may ease over time, but other factors (such as structural changes in exporting countries and productivity gains) seem unlikely to be reversed. Therefore, the

commodity exporting countries need to concentrate on export diversification and appropriate structural policies, in particular with regard to resource allocation and international trade.¹³

Cashin, *et.al.*(1999) point out that while temporary fluctuations occur regularly in world commodity markets, shocks to the prices of many primary commodities are typically long lasting.¹⁴ An adverse price shock to any given commodity is thus likely to depress prices for a long time. In such circumstances, government-supported price stabilisation activities and compensatory financing are likely to be ineffective, and external borrowing for consumption smoothing is likely to be unsustainable.

Efforts to stabilise the incomes of commodity producers in Fiji must also take into account the fact that Fiji's major commodities have been subject to continuous price declines since the late 1980s. The Cashin, *et.al* (1999) study indicates that the longevity of the price shocks to our major export commodities is typically long lasting.

¹³ Fiji's sugar industry is a classic example where structural policies (particularly, policies with regard to infrastructure, research and the industry's cost structure) are required to make the industry efficient enough to compete in the world market. This is especially important given that preferential prices Fiji receives for its sugar is unlikely to last forever, in the wake of WTO rules.

¹⁴ Cashin, *et.al* (1999), estimated the average and associated range (in months) of the duration of price shocks to 44 commodities from the period 1957-98. The average duration (represented by a number) denotes that half of the shocks will exceed it, the range (represented in parentheses) (90 percent confidence interval) indicates the span of months that accounts for 90 out of 100 realisations of the duration of the shocks. In the majority of cases (27 of the 44 price indices studied), it took more than five years, on average, for a shock to dissipate to half its initial magnitude. Moreover, the range surrounding the average duration of the price shock was rather wide, indicating that the duration of shocks is quite variable. According to their study, the duration of shocks to prices of commodities of interest to this study are as follows: Sugar (EU) 7, (5-10); Fishmeal 45, (18-∞); Coconut oil 70, (22-∞); sugar (free market) 116, (25-∞); and gold – permanent duration of price shocks.

6.1 Stabilisation Schemes

Clearly, both short-run volatility and long run trend movements in commodity prices present serious challenges for many developing countries because of their large impact on the balance of payments and government budgetary positions. The following are some domestic and international measures taken to stabilise incomes of commodity exporters.

6.1.1 Domestic price stabilisation

Governments have traditionally assumed a major role in smoothing the domestic effects of fluctuations in world commodity prices, typically by buying stocks of important commodities - known as buffer stocks - when prices are low and selling them when prices are high. Some of the domestic schemes include:

1. ***Stabilisation funds.*** These have been designed to deal with the impact of commodity price volatility on government revenue, especially in countries heavily dependent on metals and minerals. Ghosh and Ostry (1994) argue that the benefits that can be obtained from stabilisation funds or precautionary savings will be greater in a more volatile and uncertain environment.
2. ***Agricultural Boards.*** This is another principal type of institutional structure for government intervention. In Fiji there is one such agricultural board in operation. The Coconut Industry Development

Authority (commonly known as the Coconut Board) monitors and sets copra prices. They also maintain prices at certain level to avoid price variability.

Apart from the issue of whether governments are better than private agents at managing commodity price shocks, the success of market intervention hinges on the assumption that the commodity price shock is temporary and will reverse itself in the short run. The difficulties that many stabilisation schemes experienced from the mid-1980s onwards can be traced to a failure to take into account the negative and variable trend in commodity prices (Reinhart and Wickham, 1994).

6.1.2 International Price Stabilisation

At the international level, commodity agreements and compensatory financing from organisations such as the IMF have been used to minimise and smooth the effects of world commodity price effects.

1. ***International Commodity Agreements (ICA)***. ICAs typically restrict supply to increase average prices or simply limit price variability by allowing recourse to buffer stocks. However, these failed in the 1980s and the 1990s, as the cost of maintaining them became unsustainable – for example, the International Sugar Agreement (commenced in 1954 and lapsed in 1984 with the expiry of export quotas); similar agreements for tin, cocoa and coffee were also terminated during the period (Cashin, *et. al.*, 1999).

2. **Compensatory Finance.** This is mainly in the form of external finance from the IMF under the compensatory and contingency financing facility (CCFF) and from the EU under the STABEX and SYSMIN schemes. Fiji has taken advantage of the CCFF and the STABEX programs to stabilise their income.

- The **CCFF** is designed to smooth the effects of a temporary, exogenously caused drop in a country's merchandise export receipts below the medium-term trend. It has traditionally been a major avenue for borrowing from the IMF – annual drawings under the CCFF averaged just under one-fifth of total credits extended by the IMF during 1963-1998 (Cashin, *et. al.*, 1999).
- **STABEX and SYSMIN** schemes were introduced in the 1970s when fluctuations in commodity prices leading to short-term income losses were considered a major obstacle to sustainable growth policies in developing countries. Under Lome IV their emphasis changed gradually from income compensation to support for structural sector reforms when it became apparent that they could not sufficiently contribute to the former. Since the programmes for STABEX and SYSMIN funds with development objectives were identical to the national indicative programmes and structural adjustment policies, they created a duplication of work, bureaucracy and confusion with the beneficiaries. Finally the majority of

African, Caribbean and Pacific (ACP) countries received little or no aid under these schemes. STABEX and SYSMIN have been replaced by a new programme, which stipulates that support will be given in cases of short term fluctuations in export earnings and a simultaneous worsening of public finance.

6.2 Other Strategies

Countries may be able to trade away a large part of commodity price risk by using financial securities such as futures and options. These acquire greater importance as volatility and uncertainty increase. In addition to well developed futures and options markets with short-dated instruments for commodities, financial innovation has led to development in other instruments, (commodity swaps, commodity-linked bonds and forwards),¹⁵ which have increased the scope for hedging commodity risk (see Claessens and Duncan (1994)). Export diversification, accumulation of assets and insurance programs such as revenue insurance programs are other means of reducing downward agricultural revenue risk caused by price variability.

¹⁵ In Fiji, the Emperor Gold Mines is the only company which hedges for price variability risk by selling its gold in the forward market.

7.0 Conclusion

Primary commodities are seen as a major source of foreign exchange earnings in many developing countries, including Fiji. In line with the importance of primary commodities, this paper examined the relationship of commodity prices with output and exports. Fiji's five major commodity exports, sugar, gold, fish, coconut oil and timber were used in the analysis. The study reveals that a one percent decline in the prices of the five commodities leads to a 0.05 decline in real output.

With regard to the price elasticity of export supply, results show a positive estimated co-efficient on real commodity prices in the short run. The analysis suggests that a one- percent decline in the price of the five primary commodities leads to a 0.4 percent fall in Fiji's export supply.

Commodity prices are very volatile, exhibiting sharp jumps in some periods but have fallen throughout the last decade. The appropriate policy response to commodity price shocks should depend on whether the shock is perceived to be temporary or permanent. Appropriate policy responses to permanent negative shocks include facilitating diversification of the export base, encouraging hedging activities and fostering increases in productivity in the agricultural sector.

This paper has provided an aggregated analysis which may give rise to misleading generalisations of producer responsiveness to price

conditions. Nevertheless, there are a number of aggregate export studies¹⁶ carried out in a similar way and their results are useful for modelling and macroeconomic policymaking.

¹⁶ See for instance, Khan (1974), Bond (1985), Bahmani-Oskooee (1986), Riedel (1988), Tegen (1989), and Neil and Ross (1991).

Appendix: *Data sources and construction*

Series	Construction and sources
Gross domestic product	<p>Gross domestic product at constant factor cost.</p> <p>IMF <i>International Financial Statistics Yearbook</i> (1998); Bureau of Statistics, <i>Current Economic Statistics</i>, various issues; Reserve Bank of Fiji, <i>Quarterly Review</i> (1999).</p>
Real Exports	<p>Exports deflated by the export price index.</p> <p>IMF <i>International Financial Statistics Yearbook</i> (1998); Bureau of Statistics, <i>Current Economic Statistics</i>, various issues; Reserve Bank of Fiji, <i>Quarterly Review</i> (1999).</p>
Trading partner gross domestic product	<p>Calculated as the trade-weighted average constant price gross domestic product of Fiji's five major trading partners: Australia, New Zealand, the UK, the US and Japan.</p> <p>IMF <i>International Financial Statistics Yearbook</i> (1998); IMF <i>International Financial Statistics</i>, various issues; IMF <i>Direction of Trade Statistics</i>, various issues.</p>
Commodity Price Index	<p>The commodity price index was calculated as an index of the world market prices of Fiji's major export commodities, namely, sugar, gold, fish, timber and coconut oil (in \$F), weighted by their respective export share. For sugar, apart from the world sugar prices, preferential EU prices are also used in the calculation of the index.</p> <p>IMF <i>International Financial Statistics Yearbook</i> (1998); IMF <i>International Financial Statistics</i>, various issues;</p>
Real effective exchange rate	<p>Real effective exchange rate as calculated by the Reserve Bank of Fiji. For the period prior to 1979 an index was constructed using the trade-weighted consumer prices indices and bilateral exchange rates of Fiji's five major trading partners.</p> <p>IMF <i>International Financial Statistics Yearbook</i> (1998); IMF <i>International Financial Statistics</i>, various issues; Reserve Bank of Fiji, <i>Quarterly Review</i> (1999).</p>
Agricultural supply shocks	<p>Proxied by average sugar cane production per hectare in tonnes.</p> <p><i>Macro Technical Committee</i>.</p> <p>Bureau of Statistics, <i>Current Economic Statistics</i>, various issues.</p>

References

- Banerjee, A., Dolado, J., J. W. Galbraith, and D.H Henry (1993) *co-integration, Error-Correction, and the Econometric analysis of Non-Stationary Data*, Oxford University Press, Oxford.
- Barbour, P and A. McGregor (1998) The Fiji Agricultural Sector. *Pacific Economic Bulletin*. 13(2), pp.64-77.
- Bond, M. (1985) Export Demand and Supply for Groups of Non-Oil Developing Countries. *IMF Staff Papers*. 32(56). Pp 251-276.
- Cashin,P., Liang, H., and C. J. McDermott (1999) How Persistent Are shocks to World Prices? *IMF Working Paper*. WP/99/80.
- Chand, S (1998) Current events in Fiji: an economy adrift in the Pacific. *Pacific Economic bulletin*. 13(1)
- Cuddington, J. T (1992) Long-run Trends in 26 Primary Commodity Prices: a disaggregated look at the Prebisch-Singer hypothesis. *Journal of Development Economics*. 39, pp. 207-227.
- Deaton, A. (1999) Commodity Prices and Growth in Africa. *The Journal of Economic Perspective*. Summer, 13(3).

- Deaton, A. and R. I. Miller (1995) *International Commodity Prices, Macroeconomic Performance and Politics in Sub-Saharan Africa*. Princeton, NJ: Princeton Studies in International Finance (79).
- Engle, R. and C. Granger (1987) Co-integration and Error-Correction: Representation, Estimation and Testing. *Econometrica*, (55), pp 251-276.
- Faini, R. (1994) Export supply, capacity and relative prices. *Journal of Development Economics* (45).
- Forsyth, D. (1996) Fiji's Economy at the Crossroads. *Pacific Economic bulletin*. 11(1), pp. 1-29.
- Friedman, M. (1976) *Price Theory*. Aldine Publishing Company. Chicago. pp30-34
- Ghosh, A and J. Ostry (1994) Export Instability and the External Balance in Developing Countries. *IMF staff Papers*. 41(2), pp. 214-235.
- Goldstein, M and M. S. Khan (1978) The Supply and Demand for Imports: A structural Econometric Investigation. *American Economic Review*, 84 (March), pp. 298-308.

- Greenaway, D and M. Bleaney (1993) Long-run Trends in the Relative Price of Primary Commodities and in the Terms of Trade of Developing Countries. *Oxford Economic Papers*. No 45. pp 349-363.
- Grilli, E. R. and M. C. Yang (1988) Primary commodity prices, manufactured goods prices and terms of trade of developing countries: What the long run shows? *World Bank Economic Review* (2) pp 1-48.
- Gruen, D. and Shuetrim, G. (1994). Internationalisation and the Macroeconomy. *Proceedings of a Conference*. International Integration of the Australian Economy. Reserve Bank of Australia, Sydney.
- Junz, H. and R Rhomberg (1973) Price competitiveness in export trade among industrial countries. *American Economic Review*. 63(2), pp 412-418.
- Kremers, J. J. M., N. R. Ericsson and J. J. Dolado (1992) The Power of Cointegration Tests, *Oxford Bulletin of Economics and Statistics*, 54(3), pp. 325-348.
- Lawrence, D. (1990) An adjustment-cost model of export supply and demand. *Econometrics*, 46(3), pp 381-398.
- Lord, M. (1991) *Imperfect competition and International trade*. Oxford Univ. Press. Oxford.

- Marquez, J and C. McNeilly (1988) Income and Price Elasticities for Exports of Developing Countries. *Review of Economics and Statistics*, 70(2), pp 306-314.
- Mcloskey, D. (1982) *The Applied Theory of Prices*. 2nd Edition. Macmillan Publishing Company. New York.
- Morling, S., Hussein, S. and D. Edwin (1999) Modelling Inflation Process in Fiji. *RBF: Economic Department Working Paper* (EDWP) 99/02.
- Perron, P. (1988). Trends and Random Walks in Macroeconomic time Series: Further Evidence from a New Approach, *Journal of Economic Dynamics and Control*, 12(2/3).
- Phillips, P and P. Perron (1988). Testing for a unit Root in Time Series Regression, *Biometrika*. 75. Pp. 335-349.
- Prasad, S. (2000) Determinants of Export in Fiji. Reserve Bank of Fiji, *Working Paper* 00/03.
- Reinhart, C. M. and P. Wickham. (1994) Commodity Prices: Cyclical Weakness or Secular Decline? *IMF Staff Papers*. June 41 (2), pp175-213.

- Ridler, D. and C. A. Yandle (1972) A Simplified Method for Analysing the Effects of Exchange Rate Changes on Exports of Primary Commodity. *IMF – Staff Papers*. November (3), pp 559-578.
- Rodgers, Y. M. (1998) Empirical Investigation of One OPEC Country's Successful Non-oil Exports Performance. *Journal of Development Economics*. (55) pp 399-420.
- Rogers, A. (2000) An Analysis of the Determinants of Fiji's Imports. Reserve Bank of Fiji, *Working Paper* 00/03.
- Said, S. E. and D. A. Dickey (1984). Testing for Unit Roots in Autoregressive moving Average Models of Unknown Order, *Biometrika*, 71, pp. 599-607.
- Senhadji. A and C. Montenegro (1998) Time series Analysis of Export Demand Equation: a cross-country analysis. *IMF Working Paper*. WP/98/149.
- The Economist Intelligence Unit (1998-99) *World commodity Profile: food, feedstuff and beverages*. United Kingdom. Pp 86-94.
- United Nations (1987) *Economic and Social survey of Asia and the Pacific*. Pp 83-174.

Williams, J. and S. Morling (2000) Modelling Output Fluctuations in Fiji.
Reserve Bank of Fiji, *Working Paper 00/01*.

Zilberfarb, B. (1980) Domestic Demand Pressures, Relative Prices and
The Export supply Equation: An Empirical Evidence. *Economica*. 47,
pp. 443-450.