The relationship between Fiji Sugar Corporation's profitability and sugarcane production

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The Fiji Government's inability to resolve the differences over land leases is widely seen as a major contributor to the difficulties experienced by the sugar industry. In this paper, however, a different perspective is provided on the industry's problems. In examining the relationship between the profitability of the Fiji Sugar Corporation and sugarcane production, it is found that profitability has had a statistically significant negative effect on sugarcane production, leading to the conclusion that the Fiji Sugar Corporation has been inefficient in the management of the mills, the rail transport system, and sugarcane research.

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The sugar industry has been in the vanguard of Fiji's economic growth and development for over a century. In recent years, however, the industry has been declining in terms of both production and exports. The inability of the government to resolve the deadlock over the renewal of land leases is widely seen as the main source of the current problems in the industry (see, for instance, Prasad and Tisdell 1996, Reddy and Yanagida 1998, Lal 2000, Lal, Applegate and Reddy 2001, Reddy 2001, Kurer 2001). The likely reduction of the preferential prices received in the European Union and the United States has also been a concern for farmers, reducing the incentive to produce sugarcane in a sustainable manner. Despite the plethora of studies on Fiji's sugar industry, there has been no analysis of the relationship between sugarcane production and the performance of the Fiji Sugar Corporation (FSC). The FSC is responsible for the milling of the sugarcane, the transport system between farm and mill, management of the sugarcane research program, and the provision of advice to farmers through its extension services. It is vital, therefore, that the relationship between the Fiji Sugar Corporation's performance and sugarcane production be examined. This study aims to estimate a sugarcane production model, augmented with an 'efficiency' variable—the Corporation's profitability—in order to gauge whether it has been efficient in its management and support of sugarcane production.

Fiji's sugar industry

Sugar contributes about 7 per cent of Fiji's gross domestic product (GDP) and generates 22 per cent of total exports. With 85 to 90 per cent of sugar production exported, sugar accounts for 8.5 per cent of total foreign earnings and generates direct and indirect employment for about 51,000 people (Fiji 2002).

There are four sugar mills in Fiji, employing around 4,500 workers. In addition, there are between 14,300 and 15,000 cane cutters and about 2,000 lorry operators. In all, about 25 per cent of the economically active population in Fiji derive income from the industry. The industry's labour force is made up of both family (household) and hired labour. In 1975, there were 16,995 sugarcane farmers. By 1998 their numbers had increased to 22,146, with an average farm holding of about 4.6 hectares. Area harvested increased from 44,000 hectares in 1975 to a peak in 1993 of 75,000 hectares, before falling sharply to 45,000 hectares in 2000. Sugarcane production per hectare increased from an average of 49.1 tonnes in 1975 to 59.2 tonnes in 1993, but fell to 32 tonnes in 2000 (Fiji Bureau of Statistics 2001).

Over the past five years there has been intense debate as to who or what is responsible for the dire state of Fiji's sugar industry. The inefficiency of sugarcane farming and the apportioning of blame to the farmers for their inefficiency have been at the forefront of this debate. Often ignored, however, has been the role of the FSC. As a publicly owned monopsonist, experience in many countries would suggest that the FSC would be inefficient in its administration and operations and extract 'economic rents' through charging higher-than-market prices for its services. As an institution that controls most parts of the industry, it was expected to promote efficiency at all levels in anticipation of the reduction or even expiry of the preferential prices received for exports to the European Union and the United States.

We argue that one of the reasons for the near collapse of the FSC recently is that it has concealed its inefficiency and mismanagement and its inability to build capacity in the industry would enable Fijian sugar to compete internationally without price subsidies. We further posit that the profits declared annually by FSC for so many years until 2000 have been at the expense of investment to improve the efficiency of mills and of investment in sugarcane farming research and the transport system. Furthermore, there has been a low level of investment in the mills in order to reduce environmental damage. Some of the environmental problems include solid and liquid waste management and odour and air pollution. Studies reveal that all the sugar mills have become more waste inefficient. The production of mill-mud, ash, bagasse and water use per tonne of sugar rose to about 20 per cent between 1976 and 1996 (Kumar and Prasad 2004).

It is hypothesised, therefore, that there would be an inverse relationship between FSC's profits and sugarcane production. If the FSC's activities were beneficial to the industry, there should be a positive association between these variables. However, if our conjecture that the FSC has been able to exploit its monopsonistic position to extract 'rents' from the activities it controls while undertaking these activities in an inefficient manner is correct, the relationship between FSC profits and sugarcane production should be negative.

Model specification and data

Following Narayan (2004), a Cobb-Douglas specification for sugar production in Fiji is adopted. We use the same data set (for the period 1970–2000), where the proxies used for capital are area harvested and fertiliser use and the proxy for the labour force variable is the number of growers. Narayan modelled the impact on production of the price paid to sugarcane farmers. We do not include this variable because of the small sample available and the limited degrees of freedom; instead, consistent with our aim, we include the profits of FSC as an explanatory variable. We also include a dummy variable to capture the impact of the expiry of sugarcane land leases because of the adverse impact that this is likely to have had. Hence, the long-run model of sugarcane production takes the following form

$$SCP_t = \alpha_0 + \alpha_1 AH_t + \alpha_2 LAB_t + \alpha_3 FER_t + \alpha_4 PROFIT_t + \alpha_5 LEASE_T + \varepsilon_t \quad (1)$$

Here, a_0 represents a constant, SCP_t represents sugarcane production ('000 tonnes) at time t, AH_t represents the area harvested ('000 hectares) at time t, LAB_t represents labour force at time t, FER_t represents fertiliser use at time t, $PROFIT_t$ represents FSC's real profits/loss, and a_0 represents the error term which satisfies the classical properties.

Area harvested, labour force and fertiliser use are expected to contribute positively to sugarcane production so the *a priori* expectation was that α_1, α_2 and α_3 would be greater than zero. The expected sign on the profit variable is *a priori* ambiguous. If, for instance, it is positive it reflects the FSC's efficiency in managing production; however, if it is negative it reflects the FSC's inefficiencies. Finally, we expect the expiry of sugarcane land leases to negatively affect sugarcane production.

The Fiji Sugar Corporation is a government-owned organisation that took over from the colonial company, South Pacific Sugar Mills Ltd, in 1973—three years after Fiji's independence. The Corporation took charge of the sugar industry and provided research and extension facilities to farmers and became the sole buyer of sugarcane. It also controlled the rail system, which remains a major means of transporting cane to the mills. Like other publicly owned, monopolistic enterprises, FSC has had no motivation to behave efficiently, including investing in new technology and using innovative marketing techniques. The lack of competition in the milling sector and the support of the government to ensure that the mills continued operations, despite making losses, must explain in large part the present sorry state of the mills.

The model is estimated using annual data between 1970 and 2000. This period and frequency is chosen because it provides the most consistent data set available. All data were extracted from official publications such as the *Current Economic Statistics*, published by Fiji's Bureau of Statistics, the *Reserve Bank of Fiji Quarterly* and Fiji Sugar Corporation annual reports.

Econometric estimation

Johansen test for cointegration

Tests for cointegration between variables are now a regular part of any econometric estimation. The concept of cointegration was pioneered by Granger (1981) and extended by Engle and Granger (1987). It is based on the premise that, as is common knowledge now, many economic time-series are non-stationary. In spite of this, an appropriate linear combination between trending variables can remove the common trend component. The resulting linear combinations of the time-series variables will be stationary, implying that the relevant time-series variables are cointegrated. Evidence of cointegration rules out the possibility of the estimated relationship being 'spurious'.

To estimate the cointegrating relationship between sugarcane production and its determinants, Johansen's (1988, 1991) Full Information Maximum Likelihood (ML) technique is used. Given that it is possible to have multiple long-run equilibrium relationships between sugarcane production and its determinants, the technique described by Johansen (1988, 1991) and Johansen and Juselius (1990) allows one to determine the number of statistically significant long-run relationships between sugarcane production and its determinants. The Johansen approach to cointegration is based on vector autoregression (VAR). Consider the unrestricted VAR model represented by the following equation

$$Y_t = \alpha + \sum_{k=1}^{p} \Pi_k Y_{t-k} + \varepsilon_t \text{ , } t = 1, \ldots, T \quad (2)$$

where ε_τ is a i.i.d. ρ-dimensional Gaussian error with mean zero and variance matrix Λ, Y_τ is an (n x 1) vector of I(1) variables, and α is an (n x 1) vector of constants. Given that Y_τ is assumed to be non-stationary, specifying $\Delta Y_t = Y_\tau - Y_{t-1}$, Equation 1 can be expressed in error correction form as follows

$$\Delta Y_t = \sum_{k=1}^{p-1} \Gamma_k \Delta Y_{t-k} + \Pi Y_{t-1} + \varepsilon_t \quad (3)$$

where ΔY_t is an I(0) vector, I is an (n x n) identity matrix,

$$\Gamma_k = \sum_{k=1}^{p-1} \Pi_k - I = -(I - \Pi_1 - \ldots - \Pi_k)$$

$k = 1,2,\ldots p{-}1$

and

$$\Pi = \sum_{k=1}^{p} \Pi_k - I = -(I - \Pi_1 - \ldots - \Pi_p)$$

Johansen's approach derives maximum likelihood estimates of the cointegrating vectors for an autoregressive process with independent errors. The (n x n) matrix Π can be written as the product of θ and β, two (n x r) matrices each of rank r, such that $\Pi = \beta\theta$. The rank r of the long-run matrix determines how many linear combinations of Y_t are stationary. If $r = 0$ so that $\Pi = 0$, Equation 3 translates into a first-differenced VAR model. For $0 < r < n$, there exist r cointegrating vectors, that is, r stationary linear combinations of Y_t. The cointegrating vector Γ has the property that $\theta' Y_t$ is stationary even though Y_t is non-stationary. In this light, Equation 3 can be rewritten as

$$\Delta Y_t = \alpha + \sum_{k=1}^{p-1} \Gamma_k \Delta Y_{t-k} + (\beta\theta') Y_{t-1} + \varepsilon_t \quad (4)$$

Johansen (1988) and Johansen and Juselius (1990) have developed two tests for determining the number of cointegrating vectors: the likelihood ratio trace test and the maximum eigenvalue test. The likelihood ratio test (trace test) for the hypothesis that there are at most r cointegrating vectors is given by

$$\lambda_{tr} = -T \sum_{i=q+1}^{p} log\left(1 - \hat{\lambda}_i\right) \quad (5)$$

where T is the number of observations used for estimation, and λ_1 is the ith largest estimated eigenvalue. The null hypothesis is that the number of cointegrating vectors is less than or equal to r, where r = 0, 1, 2 and so on.

On the other hand the maximum eigenvalue test is of the form

$$\lambda_{max} = -T \, log\left(1 - \hat{\lambda}_r\right) \quad (6)$$

for testing the null hypothesis of r–1 cointegrating vectors against the alternative of r cointegrating vectors. Both tests have non-standard distributions and critical values are tabulated in Johansen and Juselius (1990:208–9).

Long-run relationship

Having found a long-run relationship, we estimated Equation 1 using the following ARDL (p, q, r, s, u) model

$$SCP_t = \alpha_0 + \sum_{i=1}^{p} \beta_i SCP_{t-1} + \sum_{i=0}^{q} \phi_i AH_{t-i} + \sum_{i=0}^{r} \gamma_i LAB_{t-i} + \sum_{i=0}^{s} \eta_i FER_{t-i} + \sum_{i=0}^{u} \varpi_i PROFIT_{t-i} + \mu_t \tag{7}$$

In estimating Equation 7, again a maximum of two lags is used, that is, $i = 2$, and the model is selected using the Schwartz Bayesian criterion.

Short-run relationship

The Granger representation theorem states that in the presence of a cointegrating relationship among variables, a dynamic error correction representation of the data exists. Following Engle and Granger (1987) we estimated the following short-run model

$$\Delta SCP_t = \beta_0 + \sum_{q=0}^{m} \eta_q \Delta SCP_{t-q-1} + \sum_{q=0}^{m} \theta_q \Delta AH_{t-q} + \sum_{q=0}^{m} \zeta_q \Delta LAB_{t-q} + \sum_{q=0}^{m} \phi_q \Delta FER_{t-q} + \sum_{q=0}^{m} \phi_q \Delta PROFIT_{t-q} + \gamma_1 LEASE_t + \delta \varepsilon_{t-1} + \mu_t \tag{8}$$

Where m_t is the disturbance term; D is the first difference operator; e_{t-1} is the error correction (one lagged error) generated from Johansen multivariate procedure (Sedgley and Smith 1994), and *m* is the lag length. By specification, Equation 8 contains lagged dependent and independent variables; a 'test down' procedure[1] is employed repeatedly until the most parsimonious specification is achieved.

Equation 8 captures both the short and long run relationships between sugarcane production and its determinants. The long-run relationship is captured by the lagged

Table 1 **Dickey Fuller (DF) and Phillips and Perron (PP) tests for unit roots**

Variables	DF statistics (lag length)	PP statistics (bandwidth)
SCP_t	–2.7241 (0)	–2.6522 (1)
ΔSCP_t	–8.8732 (0)	–8.8510 (1)
AH_t	–1.7975 (0)	–1.7614 (2)
ΔAH_t	–7.1136 (0)	–6.8750 (3)
FER_t	–2.5588 (0)	–2.6612 (2)
ΔFER_t	–4.4240 (3)	–7.2279 (6)
LAB_t	–1.7443 (0)	–1.8331 (2)
ΔLAB_t	–6.7737 (0)	–6.6473 (3)
$PROFIT_t$	–3.1109 (0)	–3.1946 (0)
$\Delta PROFIT_t$	–7.4196 (0)	–7.4924 (0)
Critical values	Levels	First difference
1 per cent	–3.6702	–3.6793
5 per cent	–2.9640	–2.9677
10 per cent	–2.6210	–2.6229

Source: Authors' calculations.

value of the long-run error correction term, which is expected to be negative, reflecting how the system converges to the long-run equilibrium implied by Equation 1; convergence is assured when δ_1 is between zero and minus one.

Empirical findings

Unit roots

A necessary but not sufficient condition for cointegration is that all series should share the same unit root properties in a univariate sense. Hence, prior to testing for cointegration, we investigate the integrational properties of each of the variables by applying the Dickey and Fuller (1979, 1981) and the Phillips and Perron (1988) tests for unit roots. Table 1 presents the DF and PP tests for the five variables—sugarcane production, hectares harvested, labour force, fertiliser use and profits—in levels and in first differences. The DF statistic suggests that all variables are integrated of order one, I(1). The PP test results, while different in their significance levels, are supportive of the DF results in that the hypothesis that the-time series contain an autoregressive unit root cannot be rejected for any of the variables in their level form. However, when all these variables are differenced once and subjected to the DF and PP tests, we find that the test statistics do not exceed the critical values. This leads us to the conclusion that all variables are stationary in their first differences.[2]

Cointegration

The results for the Johansen and Juselius cointegration test are presented in Table 2. The various hypotheses to be tested, from no cointegration, that is, r = 0 to a higher number of cointegration vectors, are reported in the first two columns of the table. The maximum eigenvalue and trace test statistics associated with the combination of I(1) levels of the U_t vector are in the third column, with the statistics ordered from highest to lowest. Starting with the null hypothesis of no cointegration, that is, r=0 among the variables, the maximum eigenvalue statistic is 61.22, which exceeds the 95 per cent critical value of 34.4. Moreover, the maximum eigenvalue statistic when r=1 is also greater than the 95 per cent critical value, implying two cointegration relationships between sugarcane production and its determinants.

On the other hand, the trace test statistic (125.18) for the null hypothesis of no cointegration r=0 exceeds the 95 per cent critical value of 75.98 and the statistic when r=1 (63.96) is also greater than the 95 per cent critical value of 53.48. Thus, the results from the maximum eigenvalue corroborate the trace test and we conclude that there are two cointegration relationships between sugarcane production and its determinants.

Long-run results

The long-run elasticities are presented in Table 3. Beginning with the variable of most interest in this study, FSC's profit situation, we find that it appears with a negative sign, implying that as FSC's profit increased over the sample period it has had a negative impact on sugarcane production. This result is interpreted to mean that FSC has been inefficient in managing activities related to sugarcane production, such as cane transport, milling operations, and research and extension services. In part, it could also be using its monopsonistic position to build profits by extracting 'rents' from the various activities in which it is engaged. There has long been a concern amongst farmers about the FSC's lack of investment in the rail transport system, which has become increasingly inefficient over the past two decades. The FSC also undertakes to supply farmers with essential food items such as rice and sugar. According to the Sugar Cane Growers Council, these functions have also been

Table 2 **Johansen's test for cointegration**

Cointegration with restricted intercepts and no trends in the VAR
Cointegration LR test based on maximal Eigenvalue of the stochastic matrix

29 observations from 1972 to 2000. Order of VAR = 2.
List of variables included in the cointegrating vector: SCP AH LAB FERT PROFIT
Intercept
List of eigenvalues in descending order: 0.87889 0.75516 0.30087 0.25786 0.13273 0.00

Null	Alternative	Statistic 95 per cent	Critical value 90 per cent	Critical value
r = 0	r = 1	61.2199	34.4000	31.7300
r<= 1	r = 2	40.8077	28.2700	25.8000
r<= 2	r = 3	10.3795	22.0400	19.8600
r<= 3	r = 4	8.6483	15.8700	13.8100
r<= 4	r = 5	4.1298	9.1600	7.5300

Use the above table to determine *r* (the number of cointegrating vectors).
Cointegration with restricted intercepts and no trends in the VAR
Cointegration LR test based on trace of the stochastic matrix

29 observations from 1972 to 2000. Order of VAR = 2.
List of variables included in the cointegrating vector: SCP AH LAB FERT PROFIT
Intercept
List of eigenvalues in descending order: 0.87889 0.75516 0.30087 0.25786 0.13273 0.00

Null	Alternative	Statistic 95 per cent	Critical value 90 per cent	Critical value
r = 0	r>= 1	125.1852	75.9800	71.8100
r<= 1	r>= 2	63.9653	53.4800	49.9500
r<= 2	r>= 3	23.1576	34.8700	31.9300
r<= 3	r>= 4	12.7781	20.1800	17.8800
r<= 4	r = 5	4.1298	9.1600	7.5300

Use the above table to determine *r* (the number of cointegrating vectors).
Cointegration with restricted intercepts and no trends in the VAR
Choice of the number of cointegrating relations using model selection criteria

29 observations from 1972 to 2000. Order of VAR = 2.
List of variables included in the cointegrating vector: SCP AH LAB FERT PROFIT
Intercept
List of eigenvalues in descending order: 0.87889 0.75516 0.30087 0.25786 0.13273 0.00

Rank	Maximised LL	AIC	SBC	HQC
r = 0	–808.4240	–833.4240	–850.5152	–838.7767
r = 1	–777.8140	–812.8140	–836.7417	–820.3079
r = 2	–757.4102	–800.4102	–829.8071	–809.6169
r = 3	–752.2204	–801.2204	–834.7192	–811.7118
r = 4	–747.8963	–800.8963	–837.1296	–812.2441
r = 5	–745.8314	–800.8314	–838.4320	–812.6074

Note: AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion
Source: Authors' calculations.

inefficiently handled. One could also conclude that FSC's profits in the past decade may have been due to its lack of expenditure on infrastructure to support farmers and sugarcane production.

The area harvested has the largest impact on sugarcane production. This finding also has direct implications for the current land problems in Fiji. Since 1997, sugarcane land leases have been expiring at a rapid rate. The bulk of the land where leases have expired is not being farmed and has returned to bushland. The area harvested has fallen sharply—from 73,000 hectares in 1997 to 45,000 hectares in 2000. Over this period sugarcane production has fallen from 3,280 thousand tonnes to 1,900 thousand tonnes (Fiji Bureau of Statistics 2001).

The coefficient on fertiliser use (a proxy for working capital) has a positive sign, implying that fertiliser use is an important input in the production process. The coefficient on the labour force variable, however, is statistically insignificant.

Short-run results

In the short-run, FSC profits also have a negative impact on sugarcane production (Table 4). Another important result is with respect to the dummy variable used to capture the effect of expiring sugarcane land leases. As expected, expiring land leases have had

Table 3 **Long-run results of the determinants of sugarcane production in Fiji, 1970–2000**

Variable	Parameter estimate	t-statistics
Constant	–1122.2[a]	–2.2571
AH_t	60.5658[b]	7.2059
LAB_t	0.0137	0.3652
FER_t	0.6217[a]	2.2638
$PROFIT_t$	–22.7172[a]	2.2571

[a]significance at the 5 per cent level
[b]significance at the 1 per cent level
Source: Authors' calculations.

Table 4 **ECM results of the determinants of sugarcane production in Fiji**

Variable	Coefficients	*t*-statistics
Constant	–1653.5[a]	–2.0982
ΔSCP_{t-1}	0.3414[a]	2.2783
ΔAH_t	89.2371[b]	6.0307
ΔLAB_t	0.0202	0.3600
ΔFER_t	0.9161[a]	2.2938
$\Delta PROFIT_t$	–33.4713[a]	–2.3817
$\Delta LEASE_t$	–494.6687	–2.0026
ΔEC_{t-1}	–1.4734[b]	–7.5258

[a] significance at the 5 per cent level
[b] significance at the 1 per cent level
Source: Authors' calculations.

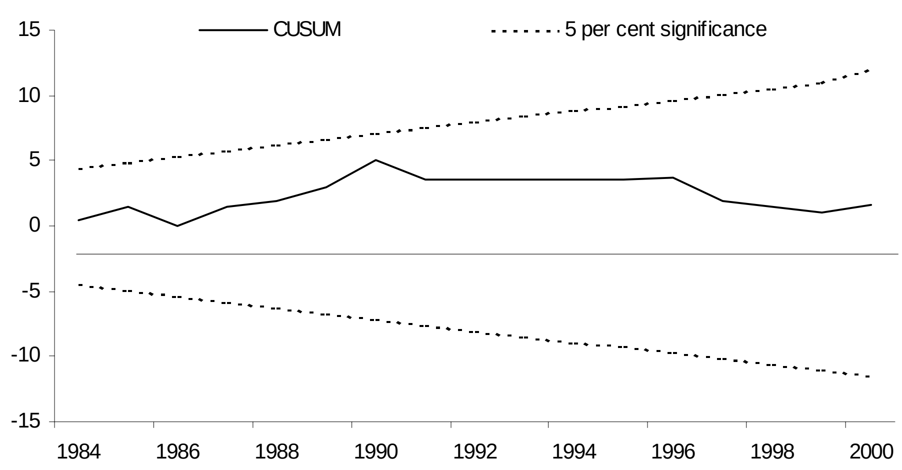
a negative impact on production. This result is statistically significant at the 5 per cent level of significance.

The result on the importance of area harvested in determining sugarcane production is, as in the long run, statistically significant. Again, the labour force is statistically insignificant in explaining sugarcane production in the short run. Last, as in the long run, we find that fertiliser use is a statistically significant determinant of sugarcane production.

The error correction term EC_{t-1}, which measures the speed of adjustment to restore equilibrium in the dynamic model, appears with a negative sign and is statistically significant at the 1 per cent level, ensuring that the series is non-explosive and that long-run equilibrium can be attained. Apart from the high significance levels of variables and the existence of a long-run relationship, the model is statistically well behaved. Several diagnostic tests were applied to the error correction model (Table 5). There is no evidence of autocorrelation in the disturbance of the error term. The WHITE tests suggest that the errors are homoskedastic and independent of the regressors. The model passes the Jarque-Bera normality test, suggesting that the errors are normally distributed. The RESET test indicates that the model is correctly specified. In addition, the adjusted R-squared of the model is high, implying an excellent fit of the model—82 per cent of the variations in sugarcane production are explained by the regressors.

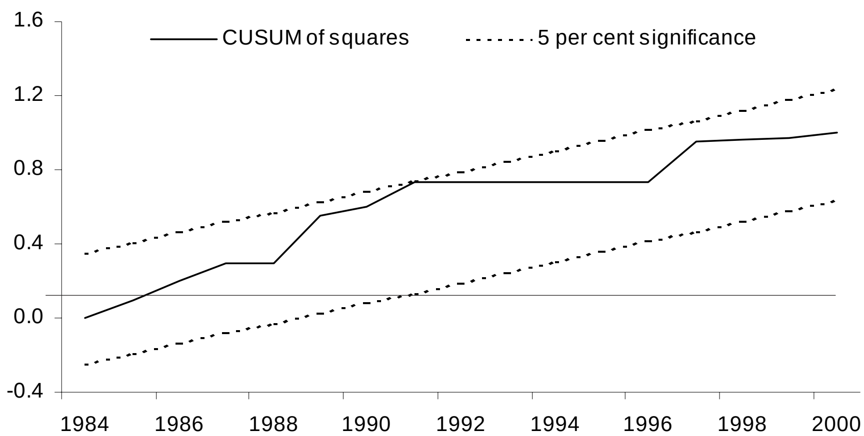
Last, the stability of the regression coefficients was evaluated using the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMSQ) of the recursive residual test for structural stability (Brown, Durbin and Evans 1975). The regression equation appears stable given that neither the CUSUM nor the CUSUMSQ test statistics exceed the bounds of the 5 per cent level of significance (Figures 1 and 2).

Figure 1 **CUSUM test for stability, 1984–2000**



Source: Authors' calculations.

Figure 2 **CUSUM squares test for stability, 1984–2000**



Source: Authors' calculations.

Table 5 **Goodness of fit and diagnostic tests**

	Statistics
R^2	0.8658
$\bar{R}^2$	0.8211
σ	0.0785
$X^2_{Auto}(1)$	0.2383
$X^2_{Norm}(2)$	0.0791
$X^2_{White}(1)$	2.4152
$X^2_{RESET}(1)$	0.1801

Note: Where σ is the standard error of the regression; $X^2_{Auto}(1)$ is the Breusch-Godfrey LM test for autocorrelation; $X^2_{Norm}(2)$ is the Jarque-Bera normality test; $X^2_{RESET}(1)$ is the Ramsey test for omitted variables/finctional form; and $X^2_{White}(1)$ is the White test for heteroscedasticity critical values for $X^2(2)$= 5.99 and $^2(1)$= 3.99.
Source: Authors' calculations.

Conclusions and policy implications

This estimation of a sugarcane production function for Fiji leads to two important results. First, the area harvested and the expiry of land leases have a strong and statistically significant impact on sugarcane production. These results support calls for urgent resolution of differences over the renewal of sugarcane land leases.

Second, in both the short run and long run, FSC's profitability has contributed negatively to sugarcane production. On the basis of this result it can be concluded that FSC has been inefficient in its management of sugarcane production and related activities and exploited its monopsonistic position to extract rents from the industry.

The results have important implications for the restructure of the sugar industry. While all stakeholders in the industry, including the government, recognise the need for restructuring, there is no agreement on a way forward. The sugar industry as a whole involves the processes of cane production, transportation, milling and marketing. In the past, there has been a tendency for the FSC and government to blame the farmers for the ills of the industry. Those who blame the farmers must realise that the sugarcane production component has never been a serious problem in the sense that farmers have continued to produce more than enough sugarcane to satisfy the quota for the EU market. There is no doubt that there are many inefficient farmers. For example, out of the 21,371 registered farmers, there are about 4,000 'non-performing' farmers who produce less than 10 tonnes of cane. These farmers will eventually move out of the industry. In fact, it is likely that farmers would move out of cane production in even greater numbers if there were alternative crop farming available to them. Such movement will leave the industry with a group of relatively productive farmers.

It appears from the results that a major problem to be dealt with in the restructure is the milling component of the industry. To a large extent, the industry's problems could be attributed to the years of inefficiency in the milling and transportation system due to poor management by the Fiji Sugar Corporation. The Corporation has disregarded the inefficiency concerns in the mills and apportioned the blame to factors such as the Master Award. For example, when Japan rejected a sugar shipment on the grounds of poor quality, FSC and government blamed the farmers for burning the cane. The basic problem is not burnt cane but the inability of the FSC, over many years, to develop the rail system so that cane can be delivered quickly to the mills for processing, hence, preserving the quality of sugar in the cane. In Brazil, most of the cane supplied to the mills is burnt, yet the quality of sugar is very high because the transport system is efficient and cane is brought to the mills within 36 hours.

The FSC has had an investment program (around F$300 million dollars expenditure over the past 15 years). However, it is misdirected and mismanaged. For example, recently F$10 million dollars was spent on a new mill at the Lautoka Mill to improve efficiency. It is reported, however, that while the old mill was crushing 45,000 tonnes per week the new mill crushes only about 30,000 tonnes a week. Despite this mismanagement of investment, the government has continued to bail out FSC through the transfer of the sugar tax revenue.

For the purpose of industry restructuring, the proposal for the role of the government and government agencies to be minimised and for the landowners, growers and workers to play a major role as shareholders in the stand alone companies appears worthy of consideration.

The results show that availability of land is a critical factor in sugarcane production. Since 1997 the area of land used for sugarcane farming and sugarcane production has declined substantially, and if the land leases are no longer available in a secure form, production will decline even further. The uncertainties surrounding land leases must be resolved in order for there to be a sustainable future for Fiji's sugar industry and for the 250,000 people dependent on the industry for their livelihoods.

Notes

[1] The 'test down' procedure involves eliminating the statistically insignificant lagged variables from the model and then re-estimating the model.

[2] A referee correctly pointed out that the unit root results may be affected by structural breaks in the data, given that Fiji has experienced coups and other shocks. As a result, we conducted the unit root test, using the Andrews and Zivot (1992) procedure, for one structural break. Our main finding is that we are unable to reject the unit root null hypothesis. To conserve space, we do not report the results here; however, the results are available from the authors upon request.

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Appendix Table 1 **Fiji sugar mill profits, 1970–2000**[a]

	Sugarcane production (tonnes)	Area harvested (acres)	Labour (total number)	Fertiliser	Profit (F$ million)	Lease
1970	2,050	40	15,800	407.3	0.5	0
1971	2,050	42	15,900	506.8	0.5	0
1972	2,100	42	16,000	660.0	0.5	0
1973	2,050	44	16,345	546.5	0.4	0
1974	2,100	44	16,555	820.7	1.0	0
1975	2,160	44	16,995	754.8	6.4	0
1976	2,212	46	17,197	787.5	9.7	0
1977	2,674	52	17,898	721.2	3.8	0
1978	2,849	54	18,383	700.0	6.7	0
1979	4,058	62	19,233	1,023.5	4.4	0
1980	3,360	64	19,567	964.7	7.7	0
1981	3,931	66	20,936	1,047.3	10.6	0
1982	4,075	69	21,558	766.7	4.3	0
1983	2,203	59	21,671	589.2	2.5	0
1984	4,290	66	22,130	826.3	–3.4	0
1985	3,043	50	22,154	681.8	–1.0	0
1986	4,109	70	22,182	1,085.0	–6.6	0
1987	2,960	67	22,255	1,023.8	13.7	0
1988	3,185	64	22,127	1,145.5	11.2	0
1989	4,099	71	21,771	1,002.2	10.6	0
1990	4,016	70	21,334	958.3	19.6	0
1991	3,380	73	24,279	557.8	7.4	0
1992	3,533	73	23,334	503.9	7.2	0
1993	3,704	74	23,454	573.1	12.2	0
1994	4,064	74	23,264	692.3	6.1	0
1995	4,110	74	22,449	702.5	11.9	0
1996	4,380	74	23,304	660.0	8.7	0
1997	3,280	72	22,100	630.0	–1.2	1
1998	2,098	57	22,146	610.0	–3.0	1
1999	2,000	52	22,312	520.0	2.0	1
2000	1,900	45	22,210	440.0	–3.3	1

[a] Fiji government bought the mills from the South Pacific Sugar Mills Limited in 1973.
Source: Fiji Bureau of Statistics, various years. *Annual Reports*, Fiji Bureau of Statistics, Suva. Fiji Sugar Corporation, various years. *Annual Reports*, Fiji Sugar Corporation, Suva.