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Paper Title: Fiji's Sugar Woes: The Challenge of the Land Tenure System, Ethnicity and the Erosion of EU Sugar Preferences

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Abstract

The non-renewal of land leases since 1997 and the impending withdrawal of the European Union's sugar preferences in 2007 have created major uncertainties in Fiji's sugar industry. In the context of this troubled environment, this paper examines the impact of various socio-economic factors on the viability of the industry by focusing on farm efficiency in sugar cane production. It was found that, in general, farmers were inefficient and produced 25% less than their potential output. Among the farm inputs, land (labour) was relatively the most (least) efficiently used input. Empirical evidence also suggests that the more productive Indian farmers rather than the natives be left to farm cane and that large scale farming should be seriously considered by amalgamating land leases. Lastly, it is possible for Fiji's sugar industry to be sustained with the use of appropriate best farming techniques to improve cane yield, and if there is successful expansion of sugar-related products.

Key words: Random coefficient production frontier, technical efficiency, sugar cane production.

1. Introduction

Sugar is said to be among the most traded commodities with exports accounting for over one quarter of global production but it also has been the subject of the most stringent government regulation and intervention for the better part of four centuries. For instance, the European Union (EU) sugar policy which began in 1965 is highly protectionist.[1] Nevertheless, the EU has granted a whole array of trade preferences to developing countries in unilateral concessions including the African Caribbean Countries (ACP) countries.[2] Under the Lome Agreement from 1975-2000 and the Cotonou Agreement from 2001 due to expire at the end of 2007, preferential access to the EU sugar market was granted to the imports of ACP countries for specified quantities of sugar at guaranteed prices. These prices were at least three to four times above the world price of sugar. The reality of the withdrawal of sugar preferences has been accelerated by the recent win in the World Trade Organisation case against EU's high sugar subsidies led by disputes registered by Australia, Brazil and Thailand. The EU is currently considering major sugar reforms for its domestic economy which has important implications for the viability of the sugar industry for ACP countries including Fiji.

[1] Other countries which protect their sugar industry include the US, Japan, and Indonesia.

[2] Most of the ACP countries are former colonies of the EU members and after the British accession to the EU in 1973, the Commonwealth countries other than those in Asia joined this group to be included under the Lome Convention.

The problem for Fiji is further exacerbated by the existing land tenure system. Most of the land under sugar cane cultivation is leased and many of the leases have expired since 1997 and face the danger of non-renewal. Tenants knew some 30 years ago in advance of the exact date when their leases were going to expire but were shocked when eviction notices did eventuate because of the expectations that leases would be renewed and the political leadership was responsible for raising these expectations. Landowners in contrast, have unrealistically high expectations of the profitability of sugar cane farming, thus having been lured into sugar cane farming with consequent eviction of tenants. The literature on land tenure (Feeny 1982; Gavin and Fafchamps 1996) shows that as potential income of land increases, the incidence of land disputes and land grabbing is high. Another related problem with land is the issue of ethnicity. Most of the land is leased out to Indo/Indian Fijians and now with the non-renewal of land, the land owners who are mostly native Fijians, are undertaking sugar cane production even though they may not have sufficient experience. In addition, the traditional/cultural constraints in the Fijian communal way of life are often argued not to be conducive for efficient farming.[3]

The absence of preferential access, the uncertainty of land lease and the ethnic differences in farming performance have major implications on the sustainability of Fiji's sugar industry which has been the backbone of the economy so far. One way to survive and remain competitive is for Fiji to increase its efficiency in sugar cane production compared to Australia, Brazil and other sugar producing ACP countries. This paper focuses on the challenges these two issues present for improving efficiency of sugar cane farmers in addition to the influence of some socio-economic factors for policy discussion. This is done by estimating the random coefficient stochastic frontier model using farm level data to find overall technical efficiency as well as the technical efficiency of each of the inputs used. Although important, the latter is often not given enough attention in previous studies. Then regression analysis is performed to empirically the impact of factors related to land lease, land quality, ethnicity and some socio-economic factors on the overall technical efficiency performance.

The rest of the paper is organised as follows. The next section provides a synopsis of Fiji's sugar industry and discusses some of the problems related to the erosion of EU preferences and land lease structure in the following section. Section four summarises the data obtained from the farm level survey and presents the methodological framework for evaluating the efficiency of sugar cane farms. Section five discusses empirical results and policy considerations. The last section concludes.

2. A Synopsis of the Fiji Sugar Industry

The Fiji sugar industry contributes approximately 7% of GDP, brings in 22% of total export earnings and provides employment to about 51 000 people (Government of Fiji 2002). Since 2000, the number of farms have stabilized to around 21 000 with active growers making up about 85% of total number of farmers registered. Table 1 shows the

[3] For example, a leading high chief, the Tui Ba, has been reported to say that "… [Fijian] landowners may be able to do sugar cane farming for a few years only, after which the land will become bushland" (*Fiji Times* 4 Aug 1999).

performance of the sugar industry over time. While cane area harvested has increased by about 30% in the last 30 decades, cane yield has however not increased significantly.

[Table 1]

It is however difficult to ascertain which aspects of the low production efficiency is due to the actions of the growers and millers. For instance, although cane yield is well within the control of the farmer except for weather conditions, the incentive to produce cane is affected by not only the profitability (and hence sugar prices) but also the way in which the transportation of cane to the mills has been set up by the Fiji Sugar Corporation and the milling operations efficiency. In general, cane production and to some extent, cane quality,[4] are field factors affected by farmer's efficiency in using resources optimally and maximising production. This paper identifies the extent to which efficiency can be improved by empirically examining the factors affecting efficiency on farms based on cane production.

3. The Troubled Environment

Here, two key aspects of the challenges Fiji faces are discussed.

The Importance of the EU Sugar Regime

As with any crop, cane production efficiency depends on expected profitability. In Fiji, this is essentially determined by EU sugar prices as 80% of sugar is exported to the EU. The first blow on price cuts came with a 20% reduction effective on the 1st July 2006 and prices are expected to fall by at least 30% by 2008 (Asian Development Bank 2005).

In the past, the Sugar Protocol has been a unique form of aid not only in terms of stable export earnings but also in the facilitation of the development of Fiji. In 2004, the price paid for ACP sugar export to EU was 600 Euros per ton while the world market price was 250 Euro. The total value of transfers assuming the agreed EU quota of 165 348 tons and 19 181 tons sold under the Special Preferential Agreement (with the latter sold at a price that is 85% of the guaranteed quota price) quota is satisfied, will amount to 64 million Euros which is about 3.1% of Fiji's GDP. This is substantial and relative to the other ACP countries, Fiji is the second largest recipient of EU income transfers.

One concern is that, of the 20 ACP sugar producers, Fiji now has the second lowest cane yield and the lowest sugar yield per harvested hectare (Quarase 2004). This does not sit well with the fact that the less developed countries (LDC) within the ACPs have been given a waiver and can enjoy preferential quotas and prices for sugar under the 'Everything But Arms' (EBA) arrangement after the end of 2007. But Fiji is not an LDC and therefore will not benefit. Furthermore, Fiji has to face fierce competition from the

[4] Cane quality is also determined by the recovery of sugar from cane and quality of raw sugar, both of which are controlled by the milling and processing operations at the factory. However, farmers can increase cane quality by reducing the burning of cane, which is unfortunately very common among Fijian farmers.

EU's commitment to other LDCs not within the ACPs, which will be provided full market access for sugar from 2009.

New trading arrangements between ACP countries and the EU, known as Economic Partnership Agreements (EPAs), will enter into force by 1st Jan 2008. These arrangements according to EU proposals should be free trade agreements where all trade restrictions between the parties are to be progressively removed but there is also an inclusion of a strong component of special and differential treatment, taking into account differing circumstances and stages of development of ACP countries. Although it is unclear what areas these may be applicable to, there is concern that Fiji may not be able to persuade the other Pacific countries to agree to the inclusion of sugar quota as a major part of the EPA.

In the absence of any such preferential market, Fiji will have to sell all its produce in the lower priced world market and the economic viability of the industry will depend on its ability to increase efficiency in order to compete effectively for a market share.

Land and Ethnic Issues

The Fijian sugar industry is quite unique in that it comprises small farmers farming individual plots under lease, who are under contract to provide sugar to the Fiji Sugar Corporation. Approximately 73% of sugar cane farmers are cultivating land leased from landowners for a period of 30 years and the first batch started expiring in 1997, with many of them not being renewed.

[Table 2]

Table 2 shows that by 2005, some 5845 agricultural leases have expired, of which, about 75% of them are sugar cane leases and a majority of the tenants are Indo-Fijians. Between 1997 and 2003, only 20% of the expired cane leases were renewed to sitting tenants and about 50% were renewed to new tenants.[5] The motivation for offering leases to new tenants is reflected in the willingness of the new tenants to pay a good will whereas the sitting tenants are less likely to make such payments. The insecurity and risk with regard to land leases has led to falling confidence in the industry and this has implications for depressed farm investments and poor access to credit. This was confirmed by 92% of the farmers who were surveyed. Lack of well defined property rights of land is a major problem plaguing Fiji's sugar industry.

In Fiji, land politics is closely related to ethnic politics. Although native Fijians own some 87% of total land, the State another 6%, with the remainder being held under freehold title, the sugar industry at the farm level comprises about 25% native Fijians and 75% Indian Fijians. The lack of participation by the indigenous population in the commercial agricultural sector has long been a concern to the government since the 1959

[5] See Native Land Trust Board 2003 Annual Report, and Sugar Cane Growers Council 2003 Annual Report.

Spate Report and 1960 Burns Report. Both reports recommended that the way forward for Fijian economic prosperity was to establish a "community of independent farmers" free from the "burden of obligations" related to the communal way of living in the villages. The socio-cultural constraints of the Fijians have long been argued to hamper effective cane production (Watters 1969, Rutz 1978, Kurer 2001). But Kingi and Kompas (2005) argue that a centralized management system incorporating communal land ownership and formal groups within the native Fijians has resulted in higher technical efficiency in sugar cane performance.

Table 3 shows results from primary and secondary data on cane yield productivity disparities among the ethnic groups by various studies, all of which reinforce the view that Fijians are less productive than Indians.

[Table 3]

The inability of ethnic Fijians to raise their efficiency significantly will further reduce average farm efficiency as more ethnic Fijians enter into sugar cane production while Indian Fijians move out as their leases expire. However, these are only partial productivity measures, and the empirical model used in this paper is able to indicate the levels of overall and input specific technical efficiency, allowing a more detailed study of the performance of both types of farmers. The implications for policy are especially important given the impending withdrawal of EU sugar prices.

4. Data and Theoretical Model

The data for this study were obtained from a survey carried out in 2004 in the Nadi catchment located in the western part of Viti Levu. The sample comprised 677 farmers randomly selected from the records of the Fiji Sugar Corporation. Tables 4 and 5 provide the definition and some descriptive statistics of the variables used. Approximately 31% of the sample farmers were indigenous Fijians and 69% were Indo Fijians. On average, the latter has almost twice the length of farming experience than the indigenous farmers. While 64% of the latter own their land, in general, they also had access to better quality land than the Indo Fijians. On average, farmers were 52 years old and had about eight years of education. The average area of cane land cultivated was 8.4 acres with most of the sample farmers (84%) being full-time farmers although 71% had an alternative source of income.

[Tables 4 and 5]

The Random Coefficient Production Frontier Model

Here, we adopt the random coefficient stochastic frontier model set out in Kalirajan and Obwona (1994). The frontier concept emphasizes the idea of maximality which it embodies, and represents the 'best practice' technique. The generalized version of the frontier model can be written as:

$$\text{Ln } Y_i = \gamma_{1i} + \sum_{j=1}^{n} \gamma_{ij} \text{ Ln } X_{ij} \quad (1)$$

where i represents no. of farms;
j represents no. of inputs used;
Y = output;
X = inputs;
γ_{1i} = intercept term of the i^{th} farm; and
γ_{ij} = actual response of output to the method of application of the j^{th} input used by the i^{th} farm.

Since intercepts and slope coefficients can vary across farms, we can write:

$$\gamma_{ij} = \bar{\gamma}_j + u_{ij}$$

$$\gamma_{1i} = \bar{\gamma}_1 + v_{1i} \quad (2)$$

where $\bar{\gamma}_j$ is the mean response coefficient of output with respect to the j^{th} input;
u_{ij} and v_{1i} are random disturbance terms; and
$E(\gamma_{ij}) = \bar{\gamma}_j$, $E(u_{ij}) = 0$, $\text{Var}(u_{ij}) = \sigma_{uit}$ for j = t and zero otherwise.

Combining equations (1) and (2):

$$\text{Ln } Y_i = \bar{\gamma}_1 + \sum_{j=1}^{k} \bar{\gamma}_j \text{ Ln } X_{ij} + \sum_{j=1}^{n} u_{ij} \text{ Ln } X_{ij} + v_{1i} \quad (3)$$

Following Aitken's generalized least squares method suggested by Hildreth and Houck (1968) and the estimation procedure by Griffiths (1972), the farm input-specific response coefficient estimates of the above model can be obtained.[6] The highest magnitude of each response coefficient and intercept given by γ^* form the frontier coefficients of the maximal production frontier. The potential output of the industry can be realised when the best practice techniques are used and this is given by

$$\text{Ln } Y_{it}^* = \gamma_1^* + \sum_{j=1}^{k} \gamma_j^* \text{ Ln } X_{ijt} \quad (4)$$

Based on the above, the model to be estimated is

[6] For details on the econometric methodology underlying this estimation, see Kalirajan and Obwona (1994).

$$\text{Ln } Y_i = \beta_0 + \beta_1 \text{Ln LAN}_i + \beta_2 \text{Ln LAB}_i + \beta_3 \text{Ln BULL}_i + \beta_4 \text{Ln TRACT}_i + \beta_5 \text{Ln FERT}_i + \beta_6 \text{Ln WEED}_i + \beta_7 \text{Ln OTHER}_i + u_i + v_i \quad (5)$$

The Cobb-Douglas production function represented by equation (5) was found to be a better fit of the data than the more flexible translog production function.[7] Using the frontier estimates, the maximum potential output can be calculated and the ratio of observed output to potential output gives the overall technical efficiency (TE) measure for the farm. This measure is then used as the dependent variable in a separate ordinary least squares regression to investigate empirically the significance of the influence of various factors as seen in equation (6).[8] An interactive term, EDU * EXP, has been included to minimise possible multicollinearity between the two variables.

$$\text{Transformed TE} = \alpha_0 + \alpha_1 \text{Ln EXP} + \alpha_2 \text{ Ln EDU} + \alpha_3 \text{Ln (EDU*EXP)} + \alpha_4 \text{ ETHN} + \alpha_5 \text{ FSTAT} + \alpha_6 \text{ OWN} + \alpha_7 \text{ CLASS} \quad (6)$$

As the TE measure is bounded between 0 and 1, a Tobit regression was attempted but the estimations failed the test for satisfactory functional form. Thus the TE measures were transformed to Ln TE - Ln (1-TE) in order to comply with standard normal assumptions of the error term in a multiple regression equation. Due to the above transformation of TE, the regression coefficients have no direct interpretation but it is possible to calculate the elasticity value from the estimated coefficient if the independent variables are logged.[9]

5. Empirical Results

Table 6 shows the frontier coefficients that define the maximum possible cane output if technical efficiency of production is 100%, that is, if farms use the best practice technique combined with the inputs and existing technology.

[Table 6]

At the outset, the validity of the modelling of equation (5) as a random coefficient specification for the present data was examined by the Lagrange multiplier test procedure suggested by Breusch and Pagan (1979). The test results indicate that the likelihood ratio test statistic of $\chi^2(8)$ value of 25.81 was significant at the 5% level, thereby supporting the modeling process. It was also found that all the input coefficients of the production frontier were significant at the 5% level except for other expenditure incurred by farmer

[7] The null hypothesis that all pairwise translog relationships between the seven input variables are zero could not be rejected by the likelihood ratio test while the null hypothesis that the coefficients of the Cobb-Douglas production function sum to one was not rejected at the 5% level of significance.

[8] Alternatively, as in some stochastic frontier estimations (Coelli et al. 1998), the factors affecting TE can be included indirectly within the specification of equation (5).

[9] Equating TE/1-TE to the antilog of the estimated coefficient value and solving for TE gives the elasticity value of the variable's effect on changes in TE.

although weedicide use was weakly significant at the 10% level. One reason for the negative impact of weedicide on cane output could be due to the lack of knowledge in how much to use or the timing of use as these determine the effectiveness of weed control on cane.

Table 6 also shows that the range of actual response coefficients of inputs for individual farms is quite substantial. These variations indicate that the methods of application of different inputs vary among farms and consequently, individual contributions of inputs to output differ from farm to farm.

Technical Efficiency Measures

The farm-specific overall technical efficiency measures are tabulated in frequency form in table 7. While the efficiency measures range from 0.63 to 0.93 for the total sample, there are considerable differences in the performance of the two ethnic groups. The Indo Fijians are on average 10% more efficient than their native counterparts. With the latter, about 25% of the farmers fall in the lowest and highest efficiency category, while about 60% of the Indo Fijians produced at least 76% of the maximum possible output. Overall, the total sample performance shows that farmers will be able to increase output by about 25% if they used farm inputs and technology efficiently.

[Table 7]

In most previous efficiency studies, the notion of technical efficiency encompasses the efficiency of total factor employment without being capable of identifying inefficiency of each individual input. Kopp (1981) explains that such measures treat the contribution of each input equally and thereby mask any differences in efficiency that might be attributed to particular factor inputs. Thus the idea of technical inefficiency should be extended to a more disaggregated level, viz input-specific technical efficiency (Kumbhakar 1988).

The random coefficient production frontier model adopted here enables the measure of not just the overall efficiency but also input-specific efficiency measures as reported in table 8. It is rational to argue that depending on which farm uses which best practice technique with which input, production coefficients would vary from farm to farm and hence result in variations in input-specific efficiency. Although some farms are able to use some of the inputs with 100% efficiency, this does not mean that it is the same farmer who uses all the inputs most efficiently.

[Table 8]

The results show quite high levels of input use efficiency but labour and tractor use are relatively less efficient. With tractors, first, they are not commonly used except in large farms which make it worthwhile or conducive for use. Second, most farmers do not own tractors and those who hire them have difficulty doing so as there is a shortage of tractors while some others share them when they are able to hire tractors. Thus there is little opportunity for farmers to learn to use it effectively and this was further hampered by

unfavourable weather conditions. In contrast, bullocks are commonly used as 73% of the farmers own bullocks, and learning by doing gains over time has positively impacted on the way in which animal power is being used. Nevertheless, improvements can still be made in cane output by farmers using about 10% less of bullock hours.

Labour is the least efficiently used input. One reason could be that self-employed labour may not necessarily be well utilized as they do not pay themselves for labour services. Another reason is that 84% of the farmers are full timers and thus, may take their time to farm in a more leisurely manner. On the other hand, fertiliser use has the highest mean efficiency. But the number of farmers using land more efficiently is more than those using fertiliser efficiently. All the farmers were on average using land such that 92.4% of the maximum possible output was being obtained. This was to gain as much as possible from the then existing high EU sugar prices. It was also found that 72% of the 98 farmers who were operating at the relatively low end of the land efficiency measure had less than three years before their land lease expired and thus had possibly less incentive to use land efficiently for cane production.

It must be noted that native farmers generally used land, bullocks, and tractors less efficiently than their counter parts (evidence not shown to conserve space). First, it is possible that since a majority of natives own their land, they do not have to grapple with the uncertainty that the Indians face and thus are less careful about land use. Furthermore, while native Fijians on average work on smaller farms (see table 5), a closer look at the survey data showed that almost 40% of them compared to 24% of the Indians, farmed less than 10 acres of land. The smaller scale of production may adversely affect the incentive to improve efficiency or make it uneconomical, for instance, to use tractors or weedicide. With bullocks, only 36% of native farmers owned them while 64% of Indian farmers owned theirs. Thus it is likely that the Indian farmers were able to learn to use bullocks more effectively, and were able to use them when they needed to rather than the natives who have to hire or borrow them.[10] It is also true to say that, on average, the native Fijians lack of experience (the survey shows that they only have half the 30 years of farming experience that the Indians have) does not put them in good stead with inputs use.

Finally, a look at how important farm size is for improved efficiency. The mean technical efficiency was found to be highest in farm areas that were above 17 acres while the lowest efficiency performance was registered by farmers with less than 8 acres. Thus larger plots of farmed land allow for better and more effective utilization of inputs and technology to more effectively produce cane.

Determinants of Technical Efficiency

[10] As explained with tractor use, farmers who did not own bullocks faced the same problem and the timing of bullock use on farms is crucial for maximising cane output in terms of land preparation. Additionally, Kingi and Kompas (2005) report that native farmers are also subject to requests from families to donate their bullocks to village ceremonies.

This section discusses the estimation results of equation (6) presented in table 9 on the factors that influence overall technical efficiency in the total sample as well as for the two ethnic types of farmers. The estimations did not suffer from functional form misspecification and were easily corrected for heterosceadasticity using the White's (1980) method. The R^2 was also reasonable for a cross sectional study as it ranged from 0.68 to 0.74.

[Table 9]

In the total sample, the positive and significant coefficient on ethnicity indicates that Indian farmers use resources and technology more efficiently than the natives. This is also apparent in the discussion earlier on input use. It is however a worrying trend if native farmers do not try hard enough to improve their farming techniques, and at the same time, when more natives without experience attempt to farm their lands after their tenant's lease expires.

As expected, land ownership is a significant factor in affecting efficiency. The owner-occupied farm efficiency is higher than the tenant farms. The significant negative impact of land tenure security on farm productivity has been widely studied (Feder and Onchan 1987; Barrows and Roth 1990). This is confirmed by the survey finding as 73% of the farmers conceded that due to the land issue, they would not hesitate to burn cane to ensure maximum income with little or no regard to the short effects on sugar recovery at the mills or the long term effects of burning on their farm productivity. Land improving measures such as soil conservation and reducing soil tillage or intercropping were not high on the farmers priority as they are costly investments given the uncertainty of farming their land beyond the lease period. Several surveys also confirm that the majority of the farms make poor returns with many continually in debt (Rao 2003). Loans from financial institutions to sugar cane farmers have thus decreased significantly in recent years because of the uncertainty about the future of the industry and the large number of bad debts written off (Fiji Development Bank 2003). It is however not surprising, that land ownership is weakly significant for the native Fijian sample when compared to the Indian sample as 64.3% of the native farmers own their land and hence face less risk.

The experience factor is also less significant in the sample of native farmers. This not only reflects the lower average farm experience of the native farmers (see table 5) but the average age of native farmers is 49 years which means that they started farming when they were quite old and thus they can be expected to be relatively less receptive to and more conservative in adopting new technologies and better practices. On the other hand, *a priori*, more years of formal education is seen to increase efficiency for both types of farmers as they can be better exposed to improved farming techniques (such as soil conservation, fertiliser and weedicide application, and using new and higher cane yielding cane varieties) as well as extension services.

However, the interaction term of experience and education is only significant for the Indian farmers, indicating that, with more experience as well as education, the marginal increase in inefficiency is certainly positive but with native farmers, the more educated they are, the less willing they are to work hard on the farm, possibly because they shun

hard work or expect to earn more given their education level. Indian farmers on the other hand have often helped out in their family's farm since they were young even when they were attending school and thus have a higher level of commitment in farming.

In terms of farming status, full-time farmers performed relatively better than part timers but this was stronger in the sample of native Fijians. This is because the natives of the rural farming community are often known to live in their respective villages and either travel to farm their land or they may help their tenants and have an arrangement of sharing proceeds with the tenant while being "full time" farmers. In fact, only 71% of full time native farmers stayed on their farms. The highly significant coefficient when the FSTAY dummy was used in the regression (in place of FSTAT) corroborates with the findings of Kingi and Kompas (2005).

The coefficient on land class is negative (the higher the land class, the greater the slope of the land) and significant. Flat land reduces cultivation costs and increases response rate from fertiliser use and efforts to minimise soil erosion from sloping land, thereby raising the efficiency of land use and cane output. Data on soil fertility was however unavailable to better assess land quality.

Is There a Sugar Solution?

The erosion of EU sugar prices has placed substantial pressure on all sugar producing ACP countries including Fiji to adopt appropriate measures to face global competition. Currently, Fiji farmers are producing 25% less cane output than is possible. The viability of the industry is further threatened by the non-renewal of land lease which had adversely affected farm investment. In fact, Kurer (2001) has expressed concern that the transfer of land to Fijian landowners after expiry would encourage the influx of inexperienced and undercapitalized Fijian farmers.[11] The empirical evidence in this study supports this assertion as native farmers on average produced 10% less cane than Indian farmers.

Other broad policy implications from the econometric evidence are as follows. First, increasing farm size by amalgamating leases to enable economies of scale in output and allow better use of inputs and technology for improved efficiency performance. Large farms are more commercially viable in a competitive environment. This will however mean that many of the current small farm households may face difficulties but given the high possibility of facing eviction after the lease expires, this may be an opportune time to form large plantations. These farmers can however be employed for a stable wage to work on the farms or to possibly work on a shared arrangement of cane proceeds that make it sufficiently attractive for them to be employees.

[11] It is also unclear how effective the Farming Assistance Scheme that commenced in 2000 to help incoming landowners with farm management courses has been. One criticism of another government scheme, Rural Farming Assistance implemented in 2002, has been the slow delivery of assistance to farmers in terms of land preparation, purchase of seed material and basic farm equipment (*Fiji Times* 14 May 2004).

One advantage to large scale farming is that their economic viability would make it easier to obtain loans from financial institutions to improve investments in farm inputs. Also, with less small scale farms, extension visits by research officers will be more feasible and easy to monitor and help if the number of farms requiring attention is small.[12]

Second, the market could resolve the issue of who should remain in the industry based on efficiency and competitiveness but this may not foster the social objective of the Fijian government to increase ethnic Fijian participation in the sugar cane industry. However, a reasonable compromise can be made on this objective by encouraging native Fijians to be involved in alternative crop farming. This is in line with the 6-year long Alternative Livelihood Project in Fiji that began in 2006 and funded by the Asian Development Bank, the Fiji government, and other local institutions. It is timely to channel available labour into these new crops especially if cane cultivation is new to them as well. With the loss of EU sugar prices, it is best if market is catered for by efficient producers.

Third, as land efficiency is significantly affected by the quality of land farmed, more should be done to prevent soil erosion, to encourage adequate and timely fertiliser and weedicide application, and control diseases. Thus, government intervention in the form of allocating more funds for research in crop management and protection and improvement, as well as extension services to ensure that information reaches the farmers. In this regard, the effort by the Fiji government to establish an independent sugar research institute effective from 1st Oct 2006 is a step in the right direction. The institute will be recruiting 28 extension officers, covering 600 growers per officer (Government of Fiji 2006).

Land efficiency can also be enhanced by using plant cane but more than 93% of those surveyed used ratoon cane of more than four years while only 3% used younger ratoon cane.[13] Although ratoon cane adversely affects cane yield, they are cheaper to grow as farmers save on the cost of buying and planting seed cane. In addition, growers are paid based on weight of cane delivered at the mills rather than the sugar yield from the cane. This has not hindered farmers from burning cane to remove weeds, creepers and dead leaves before harvesting cane. While cane burning itself is not a bad practice, it is excessive cane burning that is a problem in Fiji which has affected soil fertility and cane quality (Sugar Technology Mission 2004). The survey revealed that a majority of the farmers burnt cane if they believe that they cannot get their cane harvested in time to the mills before the end of the crushing season. Also, there is incentive to burn cane as burnt cane is given priority in being transported to the mills to prevent quick deterioration in cane quality. The farmers admitted that the penalty for delivering burnt cane was not significant to deter burning cane.

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[12] Since the inception of the sugar industry, the advisory service was provided by the Fiji Sugar Corporation. The extension service was however dismantled in 2001 due to financial constraints of the Corporation.

[13] Sugar cane can be propagated by planting sections of the stalk known as seed cane. Once the first crop called plant cane is harvested, the plant will grow back from the portion of the stalk left under the ground. The subsequent crops are known as ratoon crops.

Another way to improve cane yield and quality is crop improvement with the use of better cane varieties of high sugar yielding and resistance to diseases and pests. The survey revealed that less than 5% used more than one cane variety while at least 90% of the farmers used the Mana variety which has more weight but less sugar content and is cheaper than other varieties. It can also be ratooned for longer periods but this increases the chances of disease and infection to cane stalk. In general, farmers were not aware of the newer and improved varieties such as Naidiri and the early maturing Aiwa variety which may be more suitable for certain soil types. A mix of cane varieties may improve allocative efficiency to achieve optimal cane output.

6. Conclusion

Despite the less than "sweet" environment, sugar remains important for Fiji on a number of levels. First, in comparison to other crops, farmers have long been involved in cane farming. The geographic spread of the farms has ensured that substantial portion of the revenue derived from the sale of sugar is also widely distributed throughout rural Fiji, the one factor that no other industry has been able to replicate. It is believed that, with the help of the government such as support in terms of extension services to educate farmers on best practice crop practices as discussed above, cane production can be competitively undertaken alongside successful land consolidation to encourage large scale commercial farming. But without political will to find some solution to the land lease problem to ensure transparency and predictability, there cannot be any meaningful industry restructuring.

Second, the erosion of EU sugar prices could pressure the horizontal expansion of sugar-related activities that can enhance Fiji's industrialisation in more ways than one. One obvious option is to develop sugar refineries to derive benefits from the highest value added component of the production chain. This has long been undermined by past EU's preferential access which created a ready market for raw sugar but strongly discouraged the export of processed sugar as it was offered the same price as raw sugar.

Another option is in the area of electricity generation from bagasse, a by-product of sugar production. This will reduce Fiji's dependence on imported fossil fuels and help alleviate the current electricity crisis in the long run. The third option is to build a distillery to convert molasses, another by-product of sugar, to produce ethanol for fuel as is successfully done in Brazil and Australia.[14] The potential for other by-products to be processed to generate liquid carbon dioxide, additional molasses for animal feed and dry yeast as well as filter cake for fertilizers for export has been explored and recommended for Fiji by Nobel Sugar (2004). These up stream economic activities not only add value to sugar cane production but also generate huge employment opportunities for displaced cane farmers who are exiting the cane industry when their leases are not renewed. However, if these sugar-related sectors can be managed well, there is little doubt that Fiji's sugar industry can be revitalized in a profitable and sustainable way.

[14] This form of biodiesel is a cleaner and could possibly be a cheaper alternative to petrol.

Thus, with all these available opportunities, the erosion of EU sugar prices can be viewed as less threatening but the success of exploiting these options depends on raising farm efficiency levels which has been the focus of this paper. While it is beyond the scope of this paper to analyse the efficiency of the infrastructure in place for cane transport to the mills, the milling, processing and marketing of sugar processes, and the existing cane payment system, these nevertheless are important research areas as they play a significant role in the final product of sugar that is sold. It is however encouraging to note that considerable funding in the form of a loan of F$86 million from the Indian government has now been committed towards a more complete restructuring of the sugar industry in all these areas. It remains to be seen how effectively these funds will be used to produce the results to fulfill Fiji's sweet dreams for its sugar industry.

Table 1 Sugar Cane Yield (tons/hectare)

Year	Cane Yield
1976	48.5
1981	59.7
1986	58.6
1991	46.6
1996	59.2
2001	42.3
2002	54.6
2003	42.8
Average of 1996-2000	52
Average of 2001-2005	47

Source: Annual Reports of the Fiji Sugar Corporation, and Government of Fiji (2006).

Note: Cane yield is measured by cane produced from area harvested.

Table 2 Lease Expiry

Year of Expiry	Agricultural Leases	Sugar Cane Leases (Area in hectares)	Indo-Fijian Leases
1997	45	27 (232)	27
1998	189	129 (1463)	120
1999	231	168 (1962)	158
2000	1828	1215 (8838)	1113
2001	1808	1542 (8337)	1494
2002	479	325 (2912)	310
2003	645	466 (3240)	435
2004	332	231 (2390)	216
2005	288	244 (2490)	228

Source: World Bank (1995) and Reddy and Naidu (2001).

Table 3 Cane Yield Differentials (tons/acres) Among Ethnic Groups

Year	Sample Size	Ethnic Indians	Ethnic Fijians
1985	2596	20.36	17.55
1987	2609	20.45	17.28
1989	2645	22.82	17.90
1994*	784	22.36	19.29
1996**	397	24.36	18.82
2003***	677	21.48	16.31

Source: Data from Fiji Sugar Cane Research Centre Annual Report 1989.
*Data from World Bank survey on Seaqaqa sugar project (Kurer 2001).
**Data from survey (Reddy 1998).
***Data from this study's survey.

Table 4 Definition of Variables

Variable	Definition	Measurement
Production frontier model		
Y	Sugar cane harvested	Tons
LAN	Land area under cane crop	Acres
LAB	Total labour including hired labour	Hours
BULL	Bullock labour	Hours
TRACT	Tractor use	Hours
FERT	Quantity of fertiliser applied	Kilograms
WEED	Quantity of weedicide used	Litres
OTHER	Land rent, drainage fee, etc.	Fijian $
Inefficiency model		
EXP	Farming experience	Years
EDU	Years of schooling	Years
ETHN	Farmer's ethnicity	1 = Indian, 0 = native
FSTAT	Farming status	1 = full time, 0 = part time
FSTAY	Farmer lives on farm	1 = yes, 0 = no
OWN	Owns land	1 = yes, 0 = no
CLASS	Class of land	1 = flat, 2 = gentle, 3 = quite steep, 4 = steep

Table 5 Some Descriptive Statistics

Variable	Native Fijian	Indo-Fijian	Total sample
		Mean	
Area of cane farm in acres	7.09 (4.7)	8.92 (7.2)	8.39 (6.7)
Age of farmer	48.8 (13.2)	52.22 (12.3)	51.12 (13.2)
Years of farming experience	14.2 (10.2)	30.68 (14.1)	25.45 (14.2)
Years of schooling	8.44 (2.9)	8.32 (3.4)	8.36 (2.9)
		Percentage of farmers	
Full time farming	88.7%	81.5%	83.5%
Stay on farm	73.7%	100%	91.7%
Own land	64.3%	16.4%	31.5%
1st class land	20.2%	16.8%	17.9%
2nd class land	46.9%	26.5%	32.9%
3rd class land	25.8%	50.4%	42.7%
4th class land	7.1%	6.3%	6.5%
Sample size	213	464	677

Note: Standard deviation in parenthesis.

Table 6 Generalised Least Squares Estimates of the Frontier Model

Variables	Frontier Coefficients	Range of Actual Response Coefficients
Constant	3.89 (0.131)*	2.67 to 3.89
Land	0.71 (0.031)*	0.63 to 0.71
Labor	0.13 (0.022)*	0.10 to 0.13
Bullock hours	0.065 (0.008)*	0.057 to 0.065
Tractor hours	0.024 (0.012)*	0.019 to 0.024
Fertiliser use	0.084 (0.015)*	0.071 to 0.084
Weedicide use	- 0.015 (0.008)**	-0.019 to -0.015
Other expenditure	0.017 (0.014)	0.011 to 0.017

Note: Figures in parenthesis are standard errors.
* and ** means that the coefficient is significant at the 5% and 10% level of significance respectively.

Table 7 Frequency Distribution of Farm-Specific Technical Efficiency

Efficiency Level (%)	Number of Native Fijian Farms	Number of Indo Fijian Farms	Total Sample
61-65	37	15	52
66-70	14	69	83
71-75	96	85	181
76-80	10	183	193
81-85	36	59	95
86-93	20	53	73
Mean Efficiency	71.2	81.8	74.7

Table 8 Frequency Distribution of Input-Specific Technical Efficiency

Efficiency Measure (%)	Number of Farms				
	Land	Labour	Bullock	Tractor	Fertiliser
75-79	-	87	-	203	-
80-84	-	412	-	346	50
85-89	98	56	373	17	76
90-94	341	20	199	47	402
95-99	201	67	76	13	83
100	42	35	29	51	66
Mean Efficiency	92.4	80.6	89.5	82.7	93.7

Note: Weedicide and other expenditure have not been included as their frontier coefficients were less significant than the above inputs as seen in table 6.

Table 9 Determinants of Technical Efficiency

Variable	Native Fijians		Indo Fijians	Total Sample
Constant	2.18** (1.04)	2.04** (0.88)	1.962** (0.993)	1.893** (0.912)
Ethnicity	-	-	-	0.018** (0.007)
Stay on Farm	-	1.22* (0.412)	-	-
Experience	0.017 *** (0.009)	0.11*** (0.006)	0.013* (0.004)	0.004** (0.002)
Education	0.051 ** (0.026)	0.17** (0.008)	0.081** (0.041)	0.012** (0.005)
Experience*Education	0.008** (0.005)	0.005 ** (0.004)	0.005** (0.002)	0.003** (0.001)
Farming Status	1.306** (0.612)	-	1.48 ** (0.751)	1.125** (0.408)
Land Ownership	0.91 *** (0.578)	0.78 *** (0.445)	1.03* (0.258)	0.93** (0.371)

Note: Figures in parenthesis are standard errors.
*, **, and *** means that the coefficient is significant at the 1%, 5% and 10% level of significance respectively.

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