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# Does land lease tenure insecurity cause decreased productivity and investment in the sugar industry? Evidence from Fiji\*

Reshmi Kumari and Yuko Nakano<sup>†</sup>

Does land lease tenure insecurity cause decreased productivity and investment in the sugar industry? To answer this question, this study examined the impact of weak formal tenure lease arrangements on tenants' investment and the productivity of sugarcane in Ba province, Fiji. After controlling for potential endogeneity in the choice of lease tenure using instrumental variables (IV), it was shown that tenants under insecure lease tenure (expiring in 0–5 years) achieve significantly lower yields of sugarcane, by 6.5–11 tonnes per hectare, and plant smaller areas of new sugarcane, by 0.14–0.25 hectares on average, than do tenants under secure lease tenure. Insecure lease tenure also negatively affects chemical fertiliser use, although this impact is not statistically significant. An intervention to improve tenure security would likely enhance the production efficiency of and investment in the Fijian sugarcane industry.

**Key words:** Fiji, investment, land, sugarcane, tenure insecurity.

## 1. Introduction

Land tenure security is often considered essential for poverty reduction, improvement in economic growth and development (World Bank, 2014). Empirical evidence from sub-Saharan and Asian countries suggests that informal tenure arrangements undermine farmers' incentives to undertake land-specific investment and cause substantial losses in productivity (Gavian and Fafchamps 1996; Place and Otsuka 2001; Jacoby *et al.* 2002; Deininger and Ali 2008; Goldstein and Udry 2008). To improve tenure security, international organisations such as the World Bank, International Monetary Fund (IMF) and European Union (EU) often promote the formalisation of tenure through titling, registration and formal lease agreements (see Besley 1995; Jacoby and Minten 2007; Ali *et al.* 2012).

While many previous studies have explored the impacts of formal ownership tenure arrangements, their results are ambiguous. Several studies have found

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that attempts to formalise tenure through land certification and registration programs significantly increase tenure security, land-related investment and supply of land to the rental market (Banerjee *et al.* 2002; Deininger *et al.* 2011). Conversely, others have shown that formal land titling has no significant effects on plot-specific investment (Suyanto *et al.* 2002; Jacoby and Minten 2007; Deininger and Ali 2008). Furthermore, despite the emphasis placed on formal ownership tenure agreements, relatively little evidence exists regarding the quantitative impact of lease tenure insecurity. Relevant studies include those of Gavian and Ehui (1999), Jacoby and Mansuri (2008), and Abdulai *et al.* (2011), who showed that tenants under informal fixed-rent lease contracts achieved lower investment levels and productivity compared to owners of cultivated plots. Several studies have also indicated that results on the impacts of both informal and formal land tenure on investment and productivity may be biased because of potential endogeneity bias in tenure choice. This problem arises when the choice of land tenure is affected by unobserved factors which would also influence the level of investment and productivity. Hence, recent research has considered the endogeneity of tenure arrangements to examine the true impacts of tenure insecurity and formal land tenure systems (Besley 1995; Brasselle *et al.* 2002; Deininger and Jin 2006; Jacoby and Mansuri 2008; Abdulai *et al.* 2011; Ali *et al.* 2012).

In this study, we investigate the impact of lease tenure insecurity under formal lease arrangements on tenant investment and sugarcane productivity in Fiji by controlling for the endogeneity in tenure choice. The sugar industry is important to Fiji's economy, contributing approximately 2 per cent of the country's GDP (FSC 2011), and provides income to approximately 200,000 people in rural areas (IMF 2011). Sugarcane production, however, has continually declined over the past decade. Previous studies from Fiji have identified that weak tenure arrangements under formal leasing systems reduce investment and sugarcane yield, although these analyses have generally been descriptive (Lal *et al.* 2001; Naidu and Reddy 2002; Narayan and Prasad 2005; Prasad and Tisdell 2006).<sup>1</sup>

We investigate the economic implications of tenure insecurity on yield (tonnes per hectare), chemical fertiliser use (kilograms per hectare) and newly planted cane (hectares) using household data from Ba province, Fiji. The three major land tenure systems in Fiji are Freehold (privately owned), State (government owned) and iTaukei land (communally owned).<sup>2</sup> Land cannot be sold permanently (except for Freehold land), and individuals can only

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<sup>1</sup> The only exception is Prasad and Tisdell (2006), who used the ordinary least squares (OLS) method to show that tenants whose leases expired within ten years achieved significantly lower yield and were less likely to invest in capital and maintain soil conservation than were tenants under secured leases. Although Prasad and Tisdell (2006) contributed to the literature by examining tenure insecurity under formal leasing systems, they did not consider possible endogeneity bias in tenure choice.

<sup>2</sup> The iTaukei lease was previously known as the native lease, while the State lease was previously referred to as the Crown lease.

obtain usufruct rights to land by leasing it under formal lease agreements. The Agricultural Landlord and Tenants Act of 1977 (ALTA) allows for land leases of 30 years under both the State and iTaukei arrangements. Although ALTA protects tenants during the lease period, iTaukei lease tenants are less secure than are State tenants. iTaukei tenants lack a provision for lease extension or renewal when leases are expiring, while State tenants are able to review their lease contracts. Consequently, weak lease arrangements under the iTaukei tenure leasing system may discourage land-specific investments and create production inefficiency, especially when leases are expiring. We hypothesised that farmers under iTaukei tenure would achieve lower investment levels than those under Freehold and State tenure, thereby achieving lower sugarcane productivity when their leases were due to expire. We used instrumental variable (IV) methods to control for the endogeneity bias resulting from unobserved confounding factors between tenure choice and investment or productivity.

The structure of the paper is as follows. Section 2 describes the background of the land tenure system and sugar industry in Fiji. Section 3 explains the data and study site. Section 4 provides descriptive analysis. Section 5 presents the empirical model and estimates the impacts of tenure insecurity on yield, fertiliser use and newly planted cane area. Finally, section 6 concludes the paper.

## 2. Background and hypotheses

### 2.1 Sugar industry in Fiji

The sugarcane industry in Fiji was developed by the Colonial Sugar Refining Company (CSR), which owned and managed four sugar mills from 1879 to 1972 (Lal *et al.* 2001; Naidu and Reddy 2002). The CSR initially grew its own sugarcane on state-owned land and employed Indian labourers, who were brought to Fiji from India by the British. Between 1879 and 1916, over 60,000 Indians worked on the plantations under contracts (indenture system). These labourers were later settled as independent smallholder farmers on an average of 4 hectares of State land after the indenture system was abolished in 1916. In 1973, the CSR sold its interest to the Fiji Sugar Corporation (FSC), which is fully owned by the government. The FSC buys sugarcane from farmers, processes it into raw sugar, and sells it to the UK in the European market under the Economic Partnership Agreement (EPA). Of the proceeds from these sugar sales, 70 per cent is distributed to farmers as sugarcane payments (FSC 2010).<sup>3</sup>

Sugarcane became a priority industry for Fiji's economy during the 1970s after the country's independence (Narayan and Prasad 2005). Relatively high

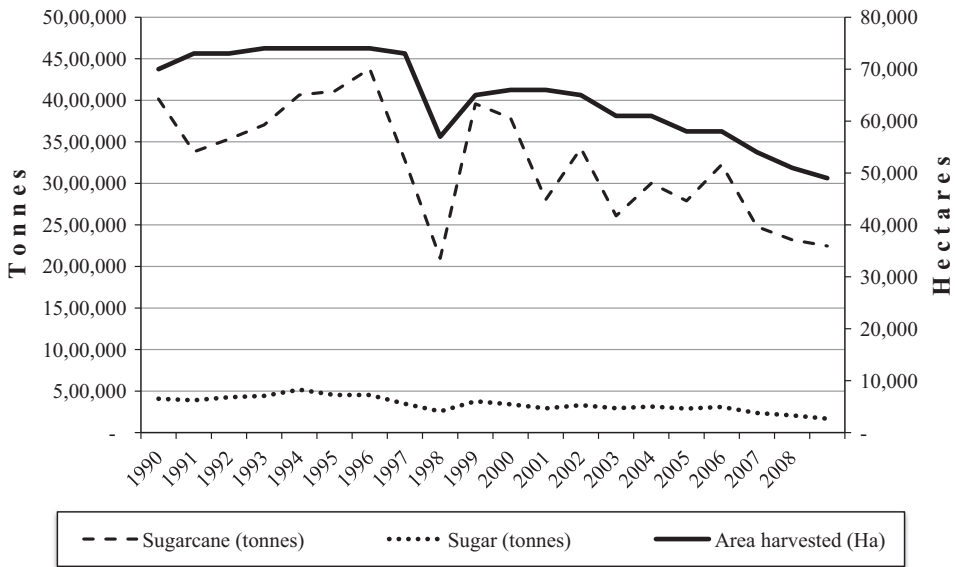
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<sup>3</sup> In Fiji, sugarcane growers are paid by tonnage. However, a quality payment system is planned to be introduced in 2016, under which payment will be based on sugar content (FSC 2010).

sugar export earnings (70 per cent of total exports) were recorded during that period (International Monetary Fund 2011). The number of farmers increased gradually from 16 995 in 1975 to over 22 000 by 1995 (FSC 2000). As shown in Figure 1, the FSC achieved its highest sugar production (over 0.5 million tonnes) in 1995. However, production has recently declined. Harvested area dropped from 66 000 hectares in 1999 to 49 000 hectares in 2009. One possible reason for this decline is the uncertainty and nonrenewal of iTaukei leases that had begun to expire in 1997 (Lal *et al.* 2001; Naidu and Reddy 2002; Prasad and Tisdell 2006)<sup>4</sup>. Although successive governments have attempted to boost sugarcane production, production has continued to decline. The EU, as the major player in Fiji’s sugar industry, has called for land lease reforms to increase productivity from the current yield of 46 tonnes per hectare to 65 tonnes per hectare (EU 2013).

### 2.2 Land tenure system in Fiji

Fiji’s current land tenure system was established under British colonial rule between 1874 and 1940.<sup>5</sup> As previously mentioned, three types of land tenure



**Figure 1** Area harvested and production of sugarcane.  
*Note:* Fiji experienced severe drought in 1998. *Source:* Fiji Bureau of Statistics (2014).

<sup>4</sup> Note that tenants who were issued a ten-year lease before ALTA came into effect in 1977 were granted a single extension of 20 years upon lease expiry (Government of the Republic of Fiji 1978, Cap.270:13.1). Therefore, the first lease expiry was experienced by iTaukei tenants in 1997.

<sup>5</sup> Fiji was a British colony from 1874 to 1970 (Gillion 1977).

exist in Fiji: Freehold, State and iTaukei. Freehold land comprises 8 per cent of the total land and is privately owned, mainly by Europeans. Only 2 per cent of Freehold land is owned by ethnic Indians and used for agricultural purposes. These ethnic Indians purchased Freehold land from Europeans in the 1930s after the Europeans divested from sugarcane farming (Gillion 1977). Freehold land follows the formal tenure system and can be easily bought and sold (Rakai *et al.* 1995).

However, other land cannot be sold permanently, either by sale, grant, transfer<sup>6</sup> or exchange, as stipulated in the 1970, 1991, 1997 and 2013 constitutions of Fiji, respectively. Individuals must rent State or iTaukei land for commercial, industrial, residential, or agricultural purposes on lease agreements under legal contracts. Of the total land in Fiji, 5 per cent is State land and is owned by the government. State land is also offered for leasing under formal lease agreements. The Ministry of Lands office is the statutory body responsible for issuing State leases and collecting rent (Government of the Republic of Fiji 1978, Cap. 132). The remaining land, now known as iTaukei land, comprises over 87 per cent of the total land and belongs to the indigenous Fijians. That land was awarded to indigenous Fijians under the Deed of Cession agreements of 1974 and is owned communally by several landowning units referred to as clans or *mataqali*.<sup>7</sup> This iTaukei land follows the formal lease system and is available for leasing to nonindigenous and indigenous people outside the *mataqali*. The iTaukei Land Trust Board (TLTB) is a statutory body responsible for administering the land, issuing leases, and collecting and distributing rents to the beneficiaries on behalf of the iTaukei land owners.<sup>8</sup>

Since 1977, both State and iTaukei leases for sugarcane cultivation have been issued for 30 years under ALTA. ALTA was introduced to rationalise the leasing of all agricultural land (Lal *et al.* 2001). All State and iTaukei tenants are charged a fixed rent of 6 per cent on the unimproved capital value, and the rent is reassessed every five years according to ALTA provisions. The most important difference between iTaukei and State land is that leases are renewed automatically only for State tenants; iTaukei tenants must apply for a new lease upon lease expiry (Government of the Republic of Fiji 1978, Cap270; personal communication with Ministry of Lands 2014). The lease period is the same under both tenure systems.

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<sup>6</sup> Although transfer of lease may be allowed, the ownership of State land remains with the government and that of iTaukei land remains with landowners.

<sup>7</sup> A total of 788 clans exist in Ba Province (Singh and Reddy 2007), and the number of members in each clan varies from several hundreds to over a thousand (Lal *et al.* 2001).

<sup>8</sup> The TLTB deducts 20 per cent of rent income as administrative costs (Prasad and Tisdell 2006).

### 2.3 Our hypotheses

Based on these observations, we developed the following hypotheses:

**Hypothesis 1:** Because the security of lease tenure for State tenants is assured by their lease renewals, the yield, fertiliser use and newly planted cane area of State tenants will be the same as those of Freehold cultivators regardless of years to lease expiry.

**Hypothesis 2:** Because only iTaukei tenants face tenure insecurity, the yield, fertiliser use and newly planted cane area of iTaukei tenants will be lower than those of Freehold and State cultivators when leases are expiring.

### 3. Data and study site

This study uses cross-sectional data for Ba province from the National Agriculture Survey (NAS), conducted by the Ministry of Agriculture of Fiji from October to November 2009. The Ba province is the most important sugarcane area in Fiji and contains two mills, called Lautoka and Rarawai. Over 65 per cent of the total sugarcane produced in Fiji comes from this province (FSC 2010). The main crop grown in Ba is sugarcane because of lease restrictions, although small areas are allotted for growing other crops, such as root crops and vegetables, and raising livestock for subsistence use. All three tenure systems exist in Ba province, and sufficient variation in tenure duration exists to test the hypotheses regarding differences in tenure insecurity among the three tenure types and different tenure durations.

The area covered by the NAS was stratified into 76 segments of 1 km<sup>2</sup> using a geographical information system (GIS). A special segment was created for large farms and for those under Freehold tenure. Households were selected randomly from each segment. From a total of 1687 selected households, only 719 households cultivated sugarcane. After excluding those with missing values, we were left with 658 households from 58 segments that could be used for analysis. The NAS surveyed the general characteristics of households and their agricultural activities. Additional information on the distances to land offices and mills, tenure and lease expiry, land holdings, fertiliser use and sugarcane production for 2009 was obtained from the FSC and matched with the NAS households by each farmer's sugarcane contract numbers. Each household cultivated sugarcane under only one tenure type. Households rarely possess land under two or more tenure types because tenure is determined geographically based on a historical process as discussed later.

**Table 1** Number of cultivators by tenure type

Variable description	Full sample	Freehold	State	iTaukei
<i>Number of Owner Cultivators</i>	81	67	0	14
Ethnic Indians among owners	67	67	0	0
Indigenous Fijians among owners	14	0	0	14
<i>Number of Tenant Cultivators</i>	577	8	246	323
Ethnic Indians among tenants	507	8	242	257
Indigenous Fijians among tenants	70	0	4	66
Observations	658	75	246	337

Table 1 displays the numbers of owner and tenant cultivators by tenure type in our data set. As shown in the table, Fijians and Indians are the two ethnicities involved in sugarcane cultivation. Of 658 total cultivators, 577 are tenants and 81 are owners. The Freehold land under sugarcane cultivation is mainly owned by ethnic Indians, although some landowners have rented out their land. All State lands are leased out, and almost all of their tenants are ethnic Indians. Among the 337 iTaukei cultivators, 323 are tenants, of whom 257 are ethnic Indians.

#### 4. Descriptive analysis

To provide better insights into the impacts of tenure insecurity, we summarised the productivity of sugarcane and investment in Table 2. Sugarcane is a long-term crop that matures in 12–14 months after planting and can be harvested for 5–7 consecutive years. On average, the yield from newly planted cane is 70 tonnes per hectare, while that from ‘ratoon’ (roots left underground) cane is 53 tonnes per hectare; however, productivity declines as ratoon ages (Lal *et al.* 2001). Thus, to test our hypotheses, we first divided the iTaukei and State leases into three categories based on years to lease expiry (0–5, 6–10 and over 10 years) and considered the overall average (0–30 years). Then, we conducted *t*-tests on the mean differences for yield, chemical fertiliser use and newly planted cane area between each category and Freehold ownership.

First, we observed almost no significant difference between the State and Freehold cultivators in yield, input use and size of newly planted cane area for either short term (0–5 years) or for longer leases (6–10 and over 10 years). These results are consistent with our first hypothesis, that State tenants achieve similarly high investment and productivity level as Freehold cultivators because the security of lease tenure for State tenants is assured by their lease renewals. However, the *t*-tests revealed significant differences between iTaukei and Freehold land in both yield and fertiliser use when leases expired within 0–5 years. On average, iTaukei tenants with short-term leases achieved a yield of 40.0 tonnes, while Freehold cultivators achieved a yield of 54.8 tonnes per hectare. This difference is statistically significant at 1 per cent. Furthermore, iTaukei tenants with short-term leases applied less fertiliser



**Table 2** Mean differences for productivity, investment and land acquisition by tenure and years to expiry

Variable description	iTaukei					State					Freehold
	Years to lease expiry					Years to lease expiry					
	0–5 years (a)	6–10 years (b)	>10 years (c)	Average (d)		0–5 years (a) <sup>1</sup>	6–10 years (b) <sup>1</sup>	>10 years (c) <sup>1</sup>	Average (d) <sup>1</sup>		
Yield (tonnes/ha)	40.0***	48.0	50.3	48.0**		51.4	53.4	53.1	53.0		54.8
Chemical fertiliser use (kg/ha)	504.5**	598.5	610.9	587.7***		627.6	641.3	655.5	647.0		660.3
Newly planted cane (ha)	0.20	0.45**	0.35*	0.32		0.24	0.38**	0.33	0.33		0.25
Household land status (1 if inherited, 0 if purchased)	0.82	0.86	0.80	0.81		0.80	0.81	0.90	0.86		0.88
Observations	71	22	244	337		46	57	143	246		75

Notes: \*, \*\* and \*\*\* indicate significance of the *t*-statistics at 10%, 5% and 1%, respectively. The *t*-tests shown in columns (a), (b), (c), (d), and (a<sup>1</sup>), (b<sup>1</sup>), (c<sup>1</sup>), and (d<sup>1</sup>) are against Freehold ownership: column (e).

(504.5 kg) than did Freehold cultivators (660.3 kg), and the difference is statistically significant at 5 per cent. However, no significant differences in yield and fertiliser use were observed between iTaukei tenants and Freehold cultivators when the iTaukei tenants held long-term leases. iTaukei tenants with long-term leases (6–10 and over 10 years) invested in even larger sizes of newly planted cane areas than did Freehold cultivators. This result implies that iTaukei tenants achieve lower investment and productivity than do Freehold cultivators only when leases are expiring.

## 5. Empirical analysis

### 5.1 Empirical model

We also conducted regression analyses to investigate the impacts of weak tenure on productivity and investment. The dependent variables are sugarcane yield (tonnes per hectare), chemical fertiliser use (kilograms per hectare) and newly planted cane area (hectares). The main independent variables of interest are a dummy for iTaukei (1 if the tenure is iTaukei) in models 1–4 and that for State lease (1 if tenure is State) in model 1 and a dummy variable for lease expiry in 0–5 years (1 if the lease expires in 0–5 years). We selected the category of lease expiry in 0–5 years because newly planted cane can be harvested at least 5 consecutive years and rents are reassessed every 5 years. Note, however, that we obtained largely consistent results when we used shorter categories of years to lease expiry such as 0–2 years and 0–3 years (results not shown).

As other independent variables, we included a dummy for the secondary education of the household head (1 if the household head had acquired up to secondary school or higher education, 0 for primary school or no education), age of the household head and number of household members by age groups in order to control for labour and human capital endowment. A dummy for tractor ownership (1 if the household owned a four-wheeled tractor) and total land holdings (hectares) were included to assess any wealth effects (e.g. Gavian and Fafchamps 1996; Goldstein and Udry 2008; Ali *et al.* 2012). A total of 18 sector (subdistrict) dummies were included to capture other unobservable sector-level characteristics such as soil quality, slope and rainfall. Detailed descriptive statistics are presented in Table 3.

To examine our first hypothesis, that the yield, fertiliser use and newly planted cane area of State tenants are the same as those of Freehold cultivators, we included dummy variables for iTaukei and State leases and their interaction terms with lease expiry in 0–5 years in our first model. The base category here is Freehold. In the presence of endogeneity, where tenure choice is correlated with the error term, OLS estimates become biased in estimating the impacts of tenure insecurity on investment and productivity. Ideally, we should have endogenised all categories of tenure choice variables, namely the State and iTaukei leases and their interaction terms with lease

**Table 3** Descriptive statistics of variables used in analysis

Variable	Mean	Std. Dev.
1 if iTaukei tenure	0.51	0.50
1 if State tenure	0.37	0.48
1 if Freehold tenure	0.11	0.32
Age of household head	51.29	11.84
Household members <15 years	0.97	1.22
Household members 15–65 years	3.58	1.58
Household members >65 years	0.31	0.59
1 if household head acquired $\geq$ high school education (0 if no or primary school)	0.46	0.50
1 if household inherited land (0 if purchased)	0.84	0.37
1 if household owns tractor (0 if hired and/or not owned)	0.27	0.44
Total land holdings (ha)	4.54	2.32
Area under sugarcane cultivation (ha)	3.46	1.80
Area harvested (ha)	3.33	1.81
Ratoon over 1 year old (ha)	0.20	0.59
Ratoon over 2 years old (ha)	0.16	0.39
Ratoon 3 years and over (ha)	2.73	1.58
Total production (tonnes)	175.29	122.00

expiring in 0–5 years, using suitable IVs. However, we failed to find a good IV for State leasing. Thus, we controlled for the endogeneity of two variables, namely iTaukei leasing and iTaukei tenure expiry within 0–5 years, using IVs, and we estimated the results using both OLS and IV methods in our second and third models, as shown in Tables 5–7. Therefore, the base categories in these models are State and Freehold. To confirm the credibility of our results, we also conducted a subsample analysis in our fourth model. We excluded all Freehold cultivators and indigenous Fijians to exclude any impact of ethnicity, thus comparing only ethnic Indian tenants under iTaukei leases with a control group of ethnic Indian tenants under State leases in our fourth model. We estimate this model using the IV method.

A suitable IV is a variable that strongly influences tenure choice but is unrelated to unobserved plot characteristics (Jacoby and Mansuri 2008). Distance from the plot to the land office in kilometres is a suitable candidate for an IV for iTaukei tenure because of historical circumstances. Land boundaries were physically marked by the land office after its establishment during colonial days (France 1969; Gillion 1977); thus, the majority of State land is found near land offices, while iTaukei land is located further away. Regarding exclusion restriction, the question arises whether the IV explains any differences in plot quality or factors such as market access. On average, the quality of land does not differ significantly among tenure types because over 90 per cent of land under sugarcane cultivation is Class III (Lal *et al.* 2001),<sup>9</sup> suggesting that the soil quality in remote areas is similar to that near

<sup>9</sup> Class III plots are shallow, moderately fertile, and require soil erosion control measures and fertilizer application (Lal *et al.* 2001).

land offices. Farmers deliver harvested cane to the mills via trucks, tractor-trailers or a railway network owned by the FSC that is accessible to most sugarcane areas. FSC delivers fertiliser to the farmers free of cost from the factory located near Lautoka mill. In fact, the two mills and land offices are located in different districts geographically. Thus, we used distance to the mill as a proxy of market access, while we used distance to the land office as an IV for tenure choice.

To construct an additional IV for iTaukei tenure expiring in 0–5 years, the dummy of lease expiry in 0–5 years was interacted with the distance to the land office. Note that we treat the years to expiry for tenure as an exogenous variable. The market for iTaukei leases expiring in 0–5 years is very small because the lease term is not extended even in the event of transfer according to the ALTA. In fact, as shown in Table 2, over 80 per cent of households under iTaukei have inherited land. Although leases are renewed for State tenants upon lease expiry, the transfer rate of State leases is also low because finding alternative State land is almost impossible given its limited availability. Thus, lease expiry in 0–5 years is treated as an exogenous variable.

## 5.2 Empirical results

Table A1 examines the validity of our IVs by showing the first-stage estimation results on determinants of leasing tenure choice. The dependent variables are iTaukei tenure in column (1) and iTaukei tenure expiry in 0–5 years in column (2). In columns (3) and (4), we show the results of the subsample analyses in which we excluded all the Freehold cultivators and indigenous Fijians, keeping ethnic Indians tenants under State leases as the reference category. We estimate all the models using OLS. The results demonstrate that distance to land office has a positive and significant coefficient on iTaukei tenure in both models (1) and (3). The results imply the validity of distance to a land office as an IV for tenure choice. We also found a positive and significant coefficient of the interaction term of distance to a land office and lease expiry in 0–5 years on iTaukei lease expiry in 0–5 years, suggesting the validity of this variable as an IV. Except for distance to a mill, which has a significant positive correlation with iTaukei tenure, other household characteristics did not affect tenure choice.

Table 4 reports the estimation results for the impact of tenure insecurity on sugarcane yield. We show the results for OLS in models (1) and (2), and for IV in models (3) and (4). As we discussed earlier, the base category in model (1) is Freehold ownership; the control in models (2) and (3) is Freehold and State cultivation, while the control in model (4) is ethnic Indians under State leases. Model (1) suggests that neither the State dummy variable nor its interaction term with tenure expiry in 0–5 years has a significant coefficient. This result supports our first hypothesis, that State tenants achieve a similarly high yield as do Freehold owners. However, yield decreased significantly at 5–10 per cent, for iTaukei tenants with lease expiry in 0–5 years in models (1) to

**Table 4** Impact of leasing and lease expiry on sugarcane yield per hectare (tonnes)

	OLS with state variables [1]	OLS without state variables [2]	IV without state variables [3]	IV with subsample [4]
State	-2.08 [1.36]			
iTaukei	-5.47 [2.40]**	-3.92 [2.10]**	-11.12 [1.33]	0.94 [0.13]
State expiring in 0–5 years	0.07 [0.03]			
iTaukei expiring in 0–5 years	-6.47 [2.26]**	-6.50 [2.27]**	-8.78 [1.93]*	-11.19 [2.18]**
Distance to mill (km)	-0.66 [2.89]***	-0.65 [2.87]***	-0.40 [1.16]	-0.57 [1.89]*
Age of household head	-0.04 [0.57]	-0.04 [0.57]	-0.05 [0.71]	-0.01 [0.16]
Household members 15–65 years	0.70 [1.88]*	0.66 [1.81]*	0.74 [1.93]*	0.31 [0.82]
Household head with secondary/higher education	2.23 [1.69]*	2.24 [1.72]*	2.03 [1.54]	2.68 [1.69]*
Household owns tractor	3.35 [2.59]**	3.34 [2.58]**	3.22 [2.53]**	1.76 [1.30]
Total land holding (ha)	0.76 [2.36]**	0.75 [2.31]**	0.70 [2.08]**	1.03 [2.84]***
Constant	60.14 [12.40]***	58.879 [12.82]***	57.029 [10.81]***	56.79 [11.39]***
Sector level dummy included	Yes	Yes	Yes	Yes
Kleibergen–Paap Wald <i>F</i> -statistic	–	–	4.64	4
Endogeneity test ( <i>chi sq</i> ) ( <i>P</i> -value)	–	–	1.7 (0.43)	0.65 (0.72)
<i>R</i> <sup>2</sup>	0.21	0.21	0.18	0.22
Observations	658	658	658	499

Notes: \*, \*\* and \*\*\* indicate significance of the *t*-statistics in brackets at 10%, 5% and 1%, respectively. The control category is Freehold in (1); State and Freehold cultivators in (2) and (3); and ethnic Indians under State lease in (4). All models include 18 sector dummies, and SE is adjusted at the segment level.

(4). This finding supports our second hypothesis that productivity declines significantly when leases are expiring for iTaukei tenants. Yield was 6.5–11 tonnes per hectare lower on average under iTaukei tenure when leases expire in 0–5 years than under Freehold ownership or State tenure. Note, however, that *R*<sup>2</sup> is relatively low in all models, suggesting that other factors may also affect the performance of the sugar industry.

The number of household members between 15 and 65 years of age positively impacted productivity in models (1), (2) and (4), implying that high labour inputs increase yield. Household heads with higher education generally achieved higher yields than those with primary school or no education. In addition, households with tractors achieved higher yields than those without. Total land holdings had a significantly positive correlation

**Table 5** Impact of leasing and lease expiry on newly planted cane (hectares)

	OLS with state variables [1]	OLS without state variables [2]	IV without state variables [3]	IV with subsample [4]
State	0.05 [1.22]			
iTaukei	0.03 [0.74]	0.01 [0.19]	0.03 [0.14]	0.13 [0.68]
State expiring in 0–5 years	–0.08 [1.16]			
iTaukei expiring in 0–5 years	–0.14 [2.71]***	–0.14 [2.65]**	–0.19 [2.04]**	–0.25 [2.05]**
Distance to mill (km)	0.00 [0.12]	0.00 [0.06]	0.00 [0.02]	0.00 [0.40]
Age of household head	0.00 [0.05]	0.00 [0.02]	0.00 [0.01]	0.00 [0.30]
Household members 15–65 years	0.01 [0.42]	0.01 [0.49]	0.01 [0.48]	0.01 [0.67]
Household head with secondary/higher education	0.06 [1.53]	0.06 [1.53]	0.06 [1.47]	0.09 [1.77]*
Household owns tractor	0.07 [1.28]	0.07 [1.30]	0.07 [1.30]	0.04 [0.72]
Total land holding (ha)	0.03 [2.20]**	0.04 [2.19]**	0.04 [2.17]**	0.05 [2.25]**
Constant	–0.13 [0.82]	–0.12 [0.69]	–0.13 [0.74]	–0.27 [1.35]
Sector level dummy included	Yes	Yes	Yes	Yes
Kleibergen–Paap Wald <i>F</i> -statistic	–	–	4.64	4.00
Endogeneity test ( <i>chi sq</i> ) ( <i>P</i> -value)	–	–	0.42 (0.81)	0.47 (0.79)
<i>R</i> <sup>2</sup>	0.13	0.13	0.13	0.14
Observations	658	658	658	499

Notes: \*, \* and \*\*\* indicate significance of the *t*-statistics in brackets at 10%, 5% and 1%, respectively. The control category is Freehold ownership in (1); State and Freehold cultivation in (2) and (3); and ethnic Indians under State lease in (4). All models include 18 sector dummies, and SE is adjusted at the segment level.

with yield. Farmers with large land holdings may have better credit access and use more chemical fertiliser, thus achieving higher yields.

Table A2 presents the estimation results for the impact of tenure insecurity on chemical fertiliser use. All controls and specifications are same as those reported in Table 4. Because soil quality is maintained only for a single cropping season (Jacoby *et al.* 2002), we considered chemical fertiliser use as a measure of short-term investment. The results in all models show no significant differences in fertiliser use for either State or iTaukei tenants, except in model (2) where iTaukei tenants used significantly lower fertiliser than did Freehold and State cultivators. However, the coefficients became insignificant once we controlled for endogeneity in models (3) and (4). This finding is consistent with the literature, which shows that tenure insecurity or expropriation risks do not affect the use of chemical fertiliser, which has only

a short-term impact on soil quality (Jacoby *et al.* 2002; Jacoby and Mansuri 2008). Except for total land holdings, other variables had statistically insignificant impacts on fertiliser use.

In Table 7, we present the estimation results for newly planted cane area with the same specifications and control variables as discussed above. In all models, we find that only iTaukei tenants with lease expiry in 0–5 years established significantly lower areas of newly planted cane. The estimated coefficients suggest that insecure tenants significantly reduce their investment in newly planted cane area, by 0.14–0.25 hectares on average, compared to other cultivators. This result supports our second hypothesis, that tenure insecurity reduces the long-term investment for iTaukei tenants when their leases are expiring. While total land holdings have a positive effect on the newly planted cane area, the coefficients of the other variables are insignificant.

## 6. Conclusion

In view of the declining sugarcane production and increasing poverty in sugarcane belt areas, we examined the impact of lease expiry on sugarcane yield, chemical fertiliser use and newly planted cane area using micro-level data from Ba Province, Fiji. We compared tenure security between three tenure types under the formal land lease system. After we controlled for endogeneity in tenure choice, the results revealed that lease tenure insecurity has a significant negative impact on productivity and investment in newly planted cane when leases are near expiry. On average, iTaukei tenants with leases expiring in 0–5 years achieve lower productivity, by 6.5–11 tonnes per hectare and make less investment in newly planted cane, by 0.14–0.25 hectares, compared to Freehold and State cultivators.

Tenure insecurity also has negative impacts on chemical fertiliser use for iTaukei tenants with leases expiring in 0–5 years, although the coefficients are statistically insignificant. Because chemical fertiliser is likely a short-term investment, weak tenure security may not significantly affect fertiliser use (Li *et al.* 1998; Jacoby *et al.* 2002; Jacoby and Mansuri 2008; Abdulai *et al.* 2011).

Overall, the study found that simply issuing leases under formal agreements did not affect investment and productivity. However, tenure security becomes a concern for iTaukei tenants when their leases are expiring, impacting productivity and long-term investment. Insecurity arises because of a lack of protection for tenants against the threat of eviction as leases expire. Given that land cannot be sold permanently under current Fijian law, tenants likely do not have the rights to be granted full ownership. However, tenure security may be strengthened through alternative measures such as providing legal protection to long-term occupants and offering lease extensions; these practices will enhance investments and improve the production efficiency of the sugarcane industry in Fiji.

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### Supporting Information

Additional Supporting Information may be found in the online version of this article:

**Table A1.** Determinants of iTaukei lease and iTaukei lease expiring in 0–5 years.

**Table A2.** Impact of leasing and lease expiry on chemical fertiliser use (kilograms/hectare).