Land Tenure, Tenure Security and Farm Efficiency: Panel Evidence from the Philippines

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Abstract

This article tests the relationships among formalized property rights, land tenure contracts, and productive efficiency in farming. Using four rounds of panel data from 230 rice farms in the Philippines, we measure the effects of land tenure arrangements on farm efficiency using a stochastic production frontier model. We test for the allocative efficiency of observed land rental markets. We also test how land tenure security affects farmers' investment decisions. Results suggest that, despite the presence of formalized titles, the rental market remains inefficient at allocating land. In contrast, the unformalized tenure contracts used by farmers appear to provide tenure security.

Keywords: land tenure, technical efficiency, agrarian reform, stochastic production frontier, Philippines
JEL: K11, O13, O17, Q12, Q15

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1. INTRODUCTION

In this article we use panel data from rice farms in the Philippines to test whether formalized property rights have led to efficient land rental markets. Additionally, we test for the security of informal land tenure contracts. These tests provide empirical evidence to inform the debate surrounding the relative merits of land marketability and tenure security in agrarian land reform. Assies (2009) divides the debate surrounding agrarian reform along two contrasting lines. The marketability-based approach attempts to provide formalized titles as a way to make land transferable and fungible (de Soto, 2000). The assumption is that once land is formally titled, efficient land sales and rental markets will arise. These markets will allow less efficient farmers to sell or rent their land to more efficient farmers. Once market-based land transfers have occurred, farmers will increase investment. This, in turn, will increase productivity. The security and rights-based approach, in contrast, recognizes that formalized titling does not necessarily lead to efficient land markets or productivity growth (Bernstein, 2002). Rather, in many cases, informal property rights may already be secure due to their social embeddedness (EU, 2004). Under this view, attempts to provide formalized titles are costly non-necessities, at best, and allow for further exploitation of already marginalized people, at worst.

Previous empirical work has conclusively demonstrated that formalized property rights are insufficient to generate an effective land sales market (Feder, 1985; Feder and Feeny, 1991; Binswanger et al., 1995). Recognizing this, recent empirical studies have focused on how tenure contracts, combined with formalized property rights, affect land rental markets. The evidence that unformalized tenure has negative collateral effects is mixed. Numerous studies have found negative effects in Asia (Feder and Noronha, 1987; Feder and Onchan, 1987), Latin America (Alston et al., 1995; Lanjouw and Levy, 2002), and Africa (Gavian and Ehui, 1999; Ahmed et al., 2002). However, several studies have found no measurable collateral effects from unformalized tenure rights (Carter and Wiebe, 1990; Brasselle et al., 2002; Guanziroli et al., 2013).

The Philippines presents a unique setting in which to study the effects of land tenure on smallholder farmer efficiency. Unlike agrarian reforms undertaken elsewhere in southeast Asia, which tended to occur piecemeal in the decades immediately following independence, agrarian reform in the Philippines was codified in the Comprehensive Agrarian Reform Law in 1988 (Hayami et al., 1990). The law was designed to redistribute public and private agricultural land, provide formalized titles, and support lease reform (Riedinger, 1995). In the two decades since the Philippines enacted its land reform, the World Bank and numerous development organizations have helped finance similar marketability-based reform in other countries (Barrows and Roth, 1990; Deininger and Binswanger, 1999; Besley and Burgess, 2000). One goal of these reforms has been to formalize property rights so as to allow land sales and land rental markets to operate more efficiently (Borras, 2006). Evidence regarding land market efficiency in the wake of the Philippines' Comprehensive Agrarian Reform Law could be construed as either justification or caution for other countries contemplating similar marketability-based reforms.

Our data come from a longitudinal study of two farming villages in the southern part of Palawan Province in the Philippines. Palawan has often been identified as the Philippines' last frontier. With approximately 25 people per square kilometer, the province is the most sparsely populated in the country. During the decade prior to when our data were collected, the province's population had been growing at a rate of 4.6 per cent annually compared to 2.7 for the Philippines as a whole (Western, 1988). As Chaiken (1996) argues, opportunities for land access and ownership were greatly limited in other parts of the Philippines, prompting both spontaneous immigration and government resettlement to Palawan from more populous areas. Putzel (1992), for example, describes how one particular land grab during the Marcos era resulted in the forced relocation of 600 families to southern Palawan, setting up a pattern in which one group of marginalized farmers was further marginalized. This marginalization and impoverishment has led farmers to expand agriculture into many environmentally-sensitive areas, resulting in considerable resource degradation, with adverse consequences both on-site and off-site (Sandalo, 1996). Southern Palawan, the location from which our sample is drawn, is especially remote, poorly connected to economic activity elsewhere in the province or the Philippines generally, and considerably poorer than farming communities in other provinces.

To accomplish our empirical aim, we run two tests. The first focuses on how technical efficiency is affected by whether a parcel is owned or rented. The assumption is that if the type of land tenure contract affects efficiency, the market fails to allocate land to those who will use it best. We find evidence that tenure type is correlated with efficiency scores in the sample and conclude that the market for land is characterized by allocative inefficiencies.

Our second test investigates whether, over time, owned parcels tend to be more efficiently operated than parcels that are rented. The assumption is that if parcels that are always owned (never rented out) are more productive than those always rented it is because they receive more investment than rented parcels. This may be due to renters perceiving that their tenure is insecure and thus choosing not to make productivity enhancing investments. We find no evidence that technical efficiency differs between parcels that are always owned and parcels that are always rented. We conclude, therefore, that tenure security or lack thereof is not undermining farm efficiency in the sample. Our findings present somewhat of a paradox. Despite an agrarian reform law that provides legally secure and verifiable land titles, land markets remain inefficient. And in spite of land rental contracts remaining verbal and thus legally insecure, tenants operate as if their rental contracts are secure. We explore theoretical work by Dixit (2004) regarding relational contracting as an explanation for this finding.

2. EMPIRICAL STRATEGY

Following Dawson et al. (1991) we define a stochastic production function:

$$y = F(x)e^{\epsilon} \tag{1}$$

where y is output, x is a vector of inputs, and ϵ is a compound disturbance term composed of two independent elements: $\epsilon = v - u$. We assume v is an idiosyncratic disturbance term which is i.i.d. $N(0, \sigma_v^2)$ while u reflects technical efficiency relative to the technical frontier. We follow Aigner et al. (1977) in assuming u is i.i.d. $N^+(0, \sigma_u^2)$. When $u = 0$, output lies on the frontier while $u > 0$ reflects production below the frontier.

The model can be adapted to accommodate panel data using a variance components model:

$$y_{it} = f(x_{kit}, \beta)e^{(v_{it} - u_{it})} \tag{2}$$

where x_{kit} is the k^{th} input $(k = 1, ..., m)$ on the i^{th} parcel $(i = 1, ..., n)$ at time t $(t = 1, ..., T)$ and β is a vector of estimated parameters. In this case, parcel level efficiency is measured by the ratio of output to the maximum achievable stochastic level given technical efficiency:

$$e^{-u_{it}} = \frac{1}{f(x_{itk})e^{v_{it}}} \tag{3}$$

2.1. Functional Forms

Debate exists around what is the most appropriate functional form for the production function in Eq. (2). Numerous early studies of rice farms in the Philippines (Jondrow et al., 1982; Dawson and Lingard, 1989; Dawson et al., 1991; Rola and Quintana-Alejandrino, 1993) employed a Cobb-Douglas specification largely due to empirical difficulties surrounding estimation of more flexible functional forms. Recent econometric and computational advancements have eased this constraint. Several recent SFA studies among rice farmers in the Philippines (Villano and Fleming, 2006; Larson and Plessman, 2009) find the Cobb-Douglas specification inadequate and adopt a translog form. We prefer the translog on conceptual grounds and in Section 4 we report tests that support this choice.

The Translog form of the stochastic production frontier is

$$
\begin{aligned}
\ln y_{it} = \beta_0 + \sum_{k}^{3} \beta_k \ln X_{kit} + \frac{1}{2} \sum_{k}^{3} \sum_{l}^{3} \beta_{kl} \ln X_{kit} \ln X_{lit} \\
+ \sum_{j}^{8} \gamma_j D_{jit} + \frac{1}{2} \sum_{k}^{3} \sum_{j}^{8} \phi_{kj} \ln X_{kit} D_{jit} + v_{it} - u_{it}
\end{aligned}
\tag{4}
$$

Output of rice (y) in kilograms per unit of parcel area planted depends on four quantitative inputs and a set of qualitative input and control variables. Our observations are indexed on parcel (i) and on time (t). The quantitative inputs are total amount of inorganic fertilizer used ($fert$) measured in kilograms per unit of parcel area planted, total cost of pesticide ($pest$) measured in pesos per unit of parcel area planted, and total labour used (lab) measured in workdays per unit of parcel area planted.

We define our qualitative variables as

$$
\begin{aligned}
\gamma_j D_{jit} = \gamma_1 D97 + \gamma_2 D99 + \gamma_3 D02 + \gamma_4 Vil \\
+ \gamma_5 Ssn + \gamma_6 Trac + \gamma_7 Cow + \gamma_8 Irr
\end{aligned}
\tag{5}
$$

$D97$, $D99$, and $D02$ are binary indicators for production years. Vil is a binary indicator distinguishing villages in this sample. We make no hypotheses about how these qualitative variables might influence output. Ssn is a binary variable where 1 signals if the observation is from the rainy season and 0 if the observation is from the dry season. We expect it to have a positive relation with yield. $Trac$ and Cow take the value of 1 if the farmer who worked the parcel owned either a hand tractor or a carabao, a draft animal used for plowing. Irr indicates whether or not the parcel was irrigated during the dry season. Tractor, carabao, and irrigation all increase the capital labour ratio for the parcel and thus should increase yield per parcel.

We include interaction terms for variable inputs but omit the interaction terms between the qualitative variables for three reasons. First, it is difficult to construct a theoretical argument regarding how these terms should interact. Second, from a practical perspective, such interaction terms introduce a substantial degree of collinearity into the model. Third, while the more complete specification might capture unexplained outcomes in the regression, we feel that a parsimonious specification is a justifiable heuristic approach.

2.2. Technical Efficiency Model

Expanding Eq. (3), the technical efficiency of production for the i^{th} parcel at the t^{th} time is defined by

$$TE_{it} = \frac{y_{it}}{\hat{y}_{it}} = \frac{y_{it}}{f(x_{itk})e^{v_{it}}} = \frac{f(x_{itk})e^{v_{it}-u_{it}}}{f(x_{itk})e^{v_{it}}} = e^{-u_{it}} \tag{6}$$

The prediction of the technical efficiencies is based on its conditional expectation, given the observable value of $v_{it} - u_{it}$ (Battese and Coelli, 1988). A parcel's distance from the efficiency frontier depends on farmer and parcel characteristics, including land tenure:

$$\begin{aligned} u_{it} = \alpha_0 + \alpha_1 Ten + \alpha_2 Silt + \alpha_3 Size + \alpha_4 Size^2 \\ + \alpha_5 Age + \alpha_6 Ncow + \alpha_7 Prctown \end{aligned} \tag{7}$$

Farmer and parcel characteristics with positive coefficients in Eq. (8) increase inefficiency (the distance to the frontier) and thus decrease technical efficiency. Ten is a binary indicator that records whether the parcel was owned (= 1) or rented (= 0) at the time of operation. The coefficient will be negative if ownership increases efficiency. A negative coefficient on the tenure term provides *prima facie* evidence that land rental markets are not allocatively efficient. We hypothesize that the coefficient will not be significantly different from zero. *Silt* is a binary indicator that registers if there was observed silt buildup in the irrigation canal feeding the parcel. The presence of a silt problem would cause inefficiencies and thus have a positive coefficient. We also examine whether the total size of the farm ($Size$) affects technical inefficiency. Given the evidence for diseconomies of scale on farms in the developing world summarized by Binswanger et al. (1995) we expect farm size to increase inefficiency. To test for diseconomies of scale in the sample we add farm size squared ($Size^2$). Diseconomies will be reflected in an insignificant coefficient on the squared term in the technical inefficiency equation.

To control for heterogeneous farmer characteristics that might affect crop yields we include several variables to act as proxies for farmer ability. These include age (Age) of the head of the household, number of carabao owned by the household ($Ncow$), and the percentage of the farm owned by the farmer ($Prctown$). Age, number of carabao, and the percentage of farm owned are expected to be negatively correlated with inefficiency.

2.3. Estimation Issues

Estimating the technical efficiency model raises three concerns, which we attempt to address. The first is that allowing the inefficiency score to vary with parcel and farmer characteristics violates the assumption that the inefficiency term is identically distributed. To address this we use the single stage procedure developed by Kumbhakar et al. (1991) to estimate the SFA model. Since u_{it} is defined by Eq. (8) it is distributed independently $N^+(\alpha^T Z_{jt}, \sigma_u^2)$

where Z_{jt} is a matrix of farm and parcel characteristics and α is a vector of parameters to be estimated. Substituting Eq. (8) into Eq. (2) we can then use the maximum likelihood method to simultaneously estimate the production frontier and the parameters for the variables that affect technical efficiency.

The second issue is that unobserved heterogeneity may bias estimation of Eq. (2) due to persistent unobserved farmer or parcel level effects. An obvious solution is to exploit the panel nature of our data to control for unobservable farmer or parcel characteristics. Following the Battese and Coelli (1995) specification for panel data estimation would allow us to control for potential unobserved heterogeneity and obtain unbiased estimates.

However, the Battese and Coelli (1995) specification generates a third estimation issue. As Karagiannis et al. (2002) point out, the distributional assumptions underlying the panel estimation method require technical inefficiency to be monotonic. Over time, technical inefficiency is either increasing or decreasing for all observations in the panel. Thus, the technical efficiency of all farmers in the data set must be either improving or deteriorating over time.

These last two issues present a choice between potential bias from unobserved heterogeneity or assuming technical inefficiency is monotonic. We believe that potential endogeneity from unobserved heterogeneity is a less significant issue then requiring technical inefficiency to be monotonic. We base this choice on numerous tests of different production estimates conducted with the data.[2] Across specifications, with and without controls for

[2]Results of this initial analysis are available from the authors upon request.

farmer and parcel effects, the production story is remarkably stable and provides little evidence of bias in our estimators. Furthermore, in the face of the data, we find the assumption that technical efficiency is monotonic to be unrealistic, since some farmers become more technically efficient at the same time that other farmers become less efficient. We therefore choose to conduct our analysis by pooling our data and controlling for time varying inefficiency through year and seasonal indicators. Furthermore, we introduce time invariant tenure variables in the second part of our analysis to measure changes in parcel level technical efficiency over time.

3. DATA

Our data come from an area in southern Palawan where considerable effort has been devoted to developing small-scale irrigation projects in suitable areas. The Philippine National Irrigation Administration targeted nearly 6,000 hectares for irrigation development during the 1990s, and by the time of our survey, 16 of 20 proposed irrigation projects had been completed. Our study sites are two of these areas of irrigation development and our survey spans eight years during which farmers were interviewed four times (1995, 1997, 1999 and 2002). Garcia et al. (1995) and Martinez and Shively (1998) describe the sites in detail.

We use unbalanced parcel level panel data in which a single household cultivates between one and four parcels. The data consist of 739 observations from 230 unique parcels. Since farmers rent in and rent out land for various reasons, it is difficult to predict the distribution of farmer and parcel characteristics across tenure type. Farmers could rent land because they are efficient and desire to expand their operations. It is equally conceivable that inefficient farmers rent in land because they lack the means to purchase it.

Table 1 presents parcel level summary statistics for the variables used in the estimation of the stochastic frontier and the technical efficiency equations. Mean yields on rented parcels are slightly higher than on owned parcels but not significantly so. One might expect fertilizer and pesticide use to be higher on owned parcels than on rented parcels and, on average, this is the case. Labour could be either correlated or uncorrelated with ownership depending on the marginal effect of labour on yield. While other studies have found evidence of "over use" of labour on owned parcels in areas where labour markets function poorly, we find no significant difference in mean labour usage per hectare across tenure types.

4. RESULTS

We first conduct a test of how parcel ownership affects technical efficiency. Using the binary variable, Ten, that measures if parcel i at time t is owned or rented, we simultaneously estimate the coefficients on the parameters in the stochastic production frontier and the efficiency effects. Since parcel i at time t could be owned while the same parcel at time q could be rented, Ten allows us to test for allocative efficiency in the market for land.

4.1. Production Function Estimates

Significant parameter estimates for the translog production function are reported in Table 2. The point estimates for labour and fertilizer are positive and statistically different from zero. The use of a hand tractor has a positive and significant impact on yields while the use of a draft animal has no impact on yields. Somewhat surprisingly, parameter estimates for the rainy season and for irrigation in the dry season are both insignificant. It is likely that the interaction terms in the translog specification account for the marginal product of inputs in specific seasons and with irrigation in the dry season, reducing the value of the single parameters.

Among interaction terms, $\ln(lab)^2$ is positive and significant, suggesting that labour is a nonlinear input in the production of rice. The coefficients on $\ln(lab) * \ln(fert)$ is negative and significant, suggesting that labour is a substitute for fertilizer use. Pesticide is more effective in the rainy season. Because the remaining interaction terms in the translog model are not significant, we conduct a Wald Test to determine if they are simultaneously equal to zero. We find that, for the 30 interaction terms, $\chi^2 = 104.6$. Thus, we reject the Cobb-Douglas functional form in favor of the translog specification.[3]

4.2. Technical Efficiency Estimates

Estimated parameters for the technical efficiency component of the model are listed in Table 2. The mean of the technical efficiency scores is 64 per cent (see Table 3).

For this study, we are most interested in tenure's effect on efficiency. In both model specifications, ownership has a negative effect on inefficiency. Parcels that are owned are operated more efficiently than parcels that are rented. This finding supports the elementary theory that owning the means of production increases one's incentives to maximize effort and therefore yields. However, the finding does not support the hypothesis that land sales or

[3] Results of the analysis using the Cobb-Douglas form can be found in the online appendix.

rental markets in Palawan are allocating land efficiently. If markets were allocatively efficient, all inefficient farmers would rent out or sell their parcels while efficient farmers would rent or purchase additional parcels. This would be reflected in an insignificant tenure variable. The lack of allocative efficiency in the land market is surprising, given that land in the region is not designated as ancestral domain and therefore is alienable and disposable. We return to this issue below.

In addition to tenure's effect on technical efficiency, we find evidence of a non-linear relationship between farm size and technical efficiency. Farm size significantly increases technical inefficiency while farm size squared significantly reduces inefficiency. Thus we find no evidence of the diseconomies of scale discussed in Binswanger et al. (1995). Rather, households working small or large farms tend to be technically efficient while households working medium sized farms are less efficient (See Figure 1). We suggest that this reflects inefficient local land rental markets. If land rental markets were allocatively efficient, we would expect to find the diseconomies of scale reported elsewhere in the literature (Berry and Cline, 1979; Feder, 1985; Binswanger et al., 1995).

Among additional variables, silt problems, as hypothesized, reduce efficiency. The estimated coefficient on the percentage of the farm owned by the household also is positive. Percent owned measures the share of total area farmed by the household that is owned by the household. Larger values represent households that own a larger percentage of the total area that they farm, while smaller values represent households that own very little of the land that they farm. Plots are farmed less efficiently by households that own a large percentage of their farm than by households that own a small percentage. We speculate that this is due to the high opportunity cost of renting additional parcels. Farmers will only expand their farm through rental contracts if they believe themselves to be efficient farmers. Inefficient farmers will not seek to expand and therefore own a larger percentage of their farm.

Since several of the idiosyncratic farmer characteristics control variables are not significant determinants of technical efficiency, we conduct a likelihood ratio test to determine whether there is, in fact, technical inefficiency in the sample. Given a null hypothesis that there is no technical inefficiency, we test for the following: $H_0 : \sigma_u^2 = 0$ or $H_1 : \sigma_u^2 > 0$. Using a one-sided generalized likelihood test we reject the null hypothesis with 99 per cent confidence and conclude inefficiency is present.

4.3. Tenure Security Estimates

Our second test investigates whether, over time, parcels that are always owned are operated more efficiently than parcels that are always rented. In order to conduct this test of land tenure security we replace Ten with more narrowly defined variables to measure tenure contracts. The goal is to incorporate time persistent effects on parcels that arise from tenure arrangements. We incorporate *Own_All* and *Rent_All* where the variables equal one if a parcel is owned or rented at every observation t. The assumption is that if rental contracts are insecure, parcels that are always owned will be subject to greater investment in physical capital (parcel improvements, etc) and soil fertility (manuring, etc) than those that are only ever rented. Conversely, for parcels that are always rented we expect to see systematic underinvestment if rental contracts are insecure. No assumptions are made about parcels that are sometimes rented and sometimes owned.

Replacing Ten with our new variables we estimate the translog model. The change of variables in our technical efficiency model has no significant effect on our estimated parameters in the stochastic frontier model, so we simply report the parameter estimates for technical efficiency. These appear in the last two columns of Table 2. Estimates of the coefficients on non-tenure related variables are similar to those reported previously.

While tenure is significantly correlated with efficiency, the characteristic of a parcel being always owned or always rented has no apparent effect on efficiency. Table 3 presents summary statistics for technical efficiency across parcel ownership types. Parcels that are always rented have a higher mean efficiency then parcels that are always owned. Using a standard t-test, we fail to reject the null hypothesis that the difference between means of the two distributions equals zero.

In Figure 2 we graph the kernel density of parcel level technical efficiency given its tenure characteristic: always rented, always owned, or neither. While the density of all three types of parcels is greatest around an efficiency score of 0.80, the difference between the distributions provides valuable insight on the tenure situation in the sample. Focusing on the distributions for parcels that are always rented and parcels that are always owned, we note that at both low and high efficiency scores the density of parcels that are always rented is greater than the density of parcels always owned. At the same time, the density of parcels always owned is greater than the density of parcels always rented around efficiency scores of 0.50. By comparing the differences in distributions, we infer that long-term renters appear to be of two types: 1) inefficient farmers that must rent because they cannot afford to purchase land (those at the bottom of the distribution), or 2) efficient farmers that rent land to expand their farmed area (those at the top of the distribution). Farmers that retain ownership of their parcels across time display average to above average efficiency levels. This does not exclude these farmers from renting in land to increase their total yields or renting out less desirable land to reduce their opportunity costs.

5. DISCUSSION

Our results provide mixed evidence regarding the effects of tenure on technical efficiency. We find no evidence that agrarian reform and the provision of land titles has resulted in efficient land rental markets. However, we do find that when land rentals occur, despite their informal nature, contracts appear to be secure. Thus we identify a situation in which the formalization of titles has been ineffective while informal contracting is effective.

Regarding land tenure and technical efficiency, we find that if farmer j owns parcel i at time t, that farmer will demonstrate greater technical efficiency than if the same farmer j rents the same parcel i at the same time t. We take this as evidence of allocative inefficiency in the market for land. If the rental market allocated parcels to those who would use them best, tenure should be insignificant in determining technical efficiency. This empirical finding is somewhat surprising since the sample farmers hold title to their land and that title is alienable and disposable. Therefore, we believe our results provide evidence of the failure of the Comprehensive Agrarian Reform Law to generate effective land rental markets in this setting.

This result is similar to Borras (2003), who examined Brazil, Columbia and South Africa, and Boucher et al. (2005), who examined Honduras and Nicaragua. All of these countries instituted marketability-based land reform focused on the granting of formalized land titles while minimizing land redistribution. In the Philippines, as of 2006, 6.8 million hectares of land had been titled but only 300,000 hectares - about 2.5 per cent of cultivable land - had been redistributed. At that time between 8.5 and 11 million rural workers remained landless (Lipton, 2009). The failure of the Comprehensive Agrarian Reform Law in itself is not surprising. More than a decade ago, Deininger and Binswanger (1999) questioned the effectiveness of agrarian reform that focused on titling at the expense of adequate land redistribution.

What is surprising is that, absent similar formalization of rental contracts, land tenure agreements in this sample appear to be secure. When we examine the security of land tenure contracts we find that, given a time invariant tenure arrangement, tenure no longer matters in the technical efficiency equation. If farmer j owns parcel i in all T observations, that farmer will be no more or less efficient then if he rented parcel i in all T observations. We take this as evidence that land rental contracts are secure. If a farmer who rented parcel i felt that his rental contract was insecure, he would refrain from making productivity enhancing investments. Over time, consistently rented parcels would experience underinvestment compared to consistently owned parcels. This would result in lower efficiency scores on rented parcels than owned parcels. We find that this is not the case and conclude that rental contracts are secure despite that they are largely legally unenforceable verbal agreements between owners and renters.

These two findings present an apparent paradox. Legally well-defined property rights have not resulted in efficient allocation of land while legally ill-defined tenure contracts have resulted in secure tenure arrangements. One potential explanation comes from Dixit's (2004) work on contracting in the shadow of the law. Dixit demonstrates that, absent external legal enforcement, a closed society can design secure relational contracts and achieve efficient market outcomes. As this society begins to integrate into the broader legalized society, the strength of its relational contracting breaks down. During a liminal period, society loses its ability to enforce relational contacts but has not yet fully integrated into the legalized society. This results in markets that are less efficient than they were when the society was completely closed. Eventually, the society passes through this period and emerges fully integrated, with legally enforceable contracts replacing relational contracts. While awaiting further empirical research, Dixit's model provides a plausible explanation for our observations.

6. CONCLUSION

Empirical studies of land tenure and technical efficiency have been fairly evenly distributed among those that find no inefficiency effects and those that find inefficiency effects. Using panel data from the Philippine province of Palawan, we find that land tenure arrangements have a significant effect on technical efficiency. We take this as evidence of allocative inefficiency in the local land rental market. At the same time, time invariant tenure arrangements have no significant correlation with technical efficiency. We take this as evidence of tenure security among farmers who rent parcels.

Thus, it appears that efforts to provide written title for land have been ineffective in stimulating rental markets. Nonetheless, renters remain secure using verbal contracts.

As Dixit (2004) shows, in an environment of imperfect markets, increasing the formality and verifiability of contracts results in a decrease in efficient outcomes. This may be one of the reasons for the patterns observed here. A further implication is that the attempt to provide formal title in the absence of more comprehensive agrarian reform, such as providing for redistribution, may actually decrease allocative efficiency. However, empirical verification of this last implication awaits further research.

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Figure 1: **Technical efficiency and farm size**

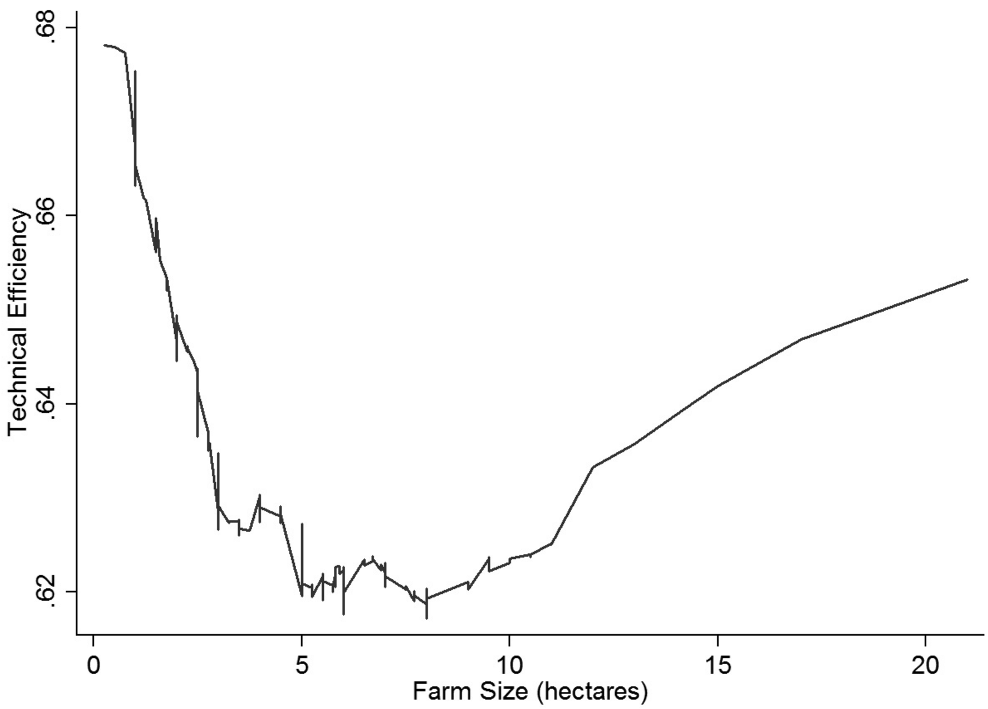

Figure 2: **Kernel density of parcel level technical efficiency**

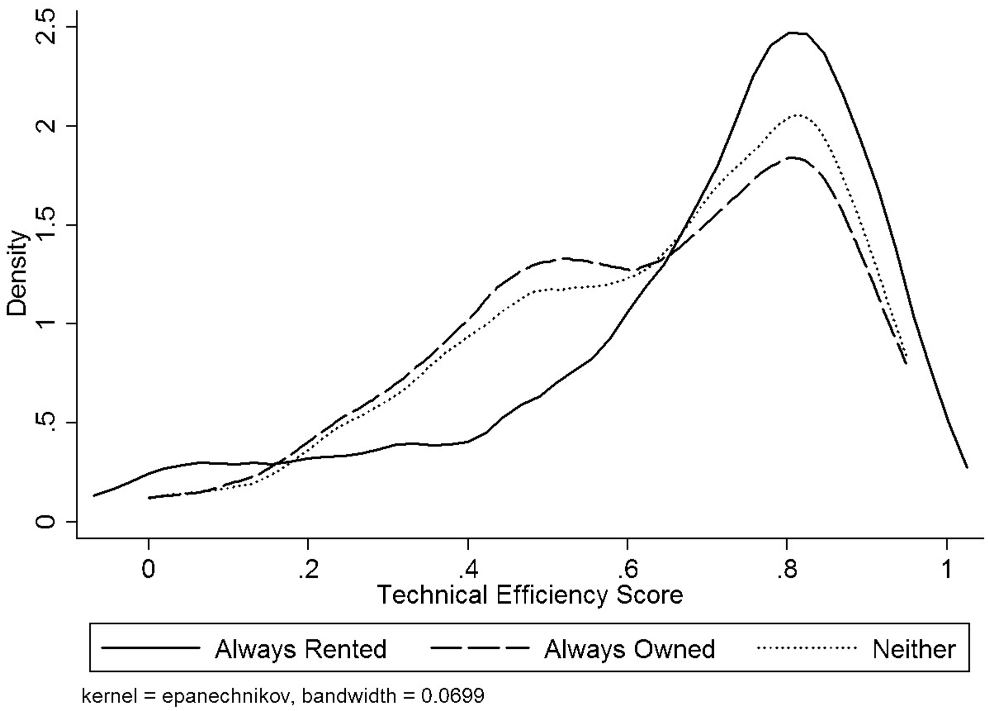

Table 1: **Parcel characteristics, by tenure status**

	Rented ($N = 257$)		Owned ($N = 460$)	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Yield (kg/ha)	3175	1553	2797	1345
Labour (days/ha)	51.0	23.9	48.9	43.2
Fertilizer (kg/ha)	137	76.0	167	127
Pesticide (pesos/ha)	1281	816	1456	1251
Silt problem (% yes)	36.4	3.00	40.3	2.28
Farm size (ha)	3.09	2.76	3.77	3.01
Age (years)	43.6	11.7	48.7	14.1
Number of carabao	1.15	1.17	1.32	1.27
Percent of cropped area owned (%)	15.9	27.7	99.5	5.87

Notes:

a. Data from 1995, 1997, 1999, and 2002 have been pooled.

b. Statistics based on status of parcel at time of production.

Table 2: **Production function and technical efficiency estimates**

	Technical Efficiency Estimates		Tenure Security Estimates	
Variables	Coeff. Estimates	Robust SE	Coeff. Estimates	Robust SE
$\ln(lab)$	1.26^{***}	0.29		
$\ln(fert)$	0.81^{***}	0.17		
Tractor	0.74^{**}	0.33		
$\ln(lab)^2$	0.27^{***}	0.10		
$\ln(lab) * \ln(fert)$	-0.41^{***}	0.09		
$\ln(pest) * Ssn$	-0.29^{***}	0.07		
Intercept	2.90^{***}	1.07		
Tenure	-0.84^{**}	0.38		
Always rented			0.24	0.26
Always owned			0.13	0.22
Silt problem	0.62^{***}	0.17	0.66^{***}	0.17
Farm size	0.20^{***}	0.08	-0.23^{***}	0.07
Farm size^2	-0.01^{**}	0.00	-0.01^{***}	0.00
Age	-0.01	0.01	-0.01	0.01
Carabaos	-0.08	0.07	-0.07	0.07
Percent owned	1.01^{**}	0.43	0.19	0.28
Log-likelihood	-586.55		-586.48	
Observations	739		739	

Notes:

a. All specifications include jointly significant village and year dummy variables.

b. For production function, table reports significant variables only.

c. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: **Mean technical efficiency**

Variable	N	Mean	Std. Dev.	Min	Max
Technical efficiency	739	0.64	0.22	0.01	0.95
Transfer parcels only	259	0.65	0.22	0.01	0.94
Parcels always rented	131	0.67	0.24	0.01	0.96
Parcels always owned	349	0.61	0.22	0.01	0.95