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The Impact of Landownership Security: Theory and Evidence from Thailand

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This article develops a model of farmers' land acquisition and investment decisions. The model clarifies the relation between land values, landownership security, and credit markets. The risk of eviction on untitled lands and the advantages in access to credit associated with titled land are shown to account for the higher price of titled land. Furthermore, observed land prices are distorted when credit is priced below the opportunity cost of capital and the risk of eviction is positive. Therefore social benefit analysis of land titling cannot utilize land prices without correcting for these distortions. The article offers formulas for performing such corrections. Econometric estimates of the value of legal ownership in three provinces of Thailand using cross-section land price data show a statistically significant effect of ownership security on land price. The econometric estimates of ownership security are combined with the formulas generated by the model to yield estimates of the social benefit of land titling in the three provinces. The analysis implies that granting full legal ownership to squatters can be a socially beneficial policy in many provinces.

The evolution of individual land rights in rural areas and of enforcement mechanisms to implement and maintain them is closely related to increases in population density and to advances in agricultural technology. As land becomes scarce, societies that practice shifting cultivation or long fallow periods to maintain land fertility must adopt fertility-restoring technologies that will allow continuous exploitation of land. Such technologies require investment of both capital and effort and an incentive for cultivators to undertake these expenses. Such an incentive is enhanced when the right to cultivate continuously and to transfer a given tract of land is secured and enforced by an effective legal system. An almost universal institution for enforcing land rights is a unified

system of land registration and documentation in which the state provides landowners with proof of ownership of well-defined tracts of land.

Agricultural development is almost uniformly related to the emergence of rural credit markets, both formal and informal. Credit transactions often require the availability of explicit or implicit collateral. Land is an attractive collateral, provided that the owners-borrowers can assure the lender of their ability to transfer the land. A unified land registration system is a mechanism for providing the lender with such an assurance.

It follows that the institution of land registration and titling can have significant economic consequences in the agricultural sector. The purpose of this article is to gain both qualitative and quantitative insights on the economic implications of land titles through an analysis of land values in rural Thailand. Land values reflect the economic benefits generated by land and are therefore a plausible indicator for investigation in a study of the effects of secured (titled) ownership.

Much of the literature concerned with the valuation of agricultural land pertains to the United States (Pope and others 1979; Barry 1980; Castle and Hoch 1982; Shalit and Schmitz 1982, 1984; Pope 1985). This literature does not address the implications of ownership insecurity and the value of titling, which are more relevant in many developing countries, where property rights in the rural sector are neither well defined nor strictly enforced.

A relevant line of work can be found, however, in the analysis of housing values in cities of developing countries where squatter settlements are common (Jimenez 1982, 1984). Housing values in cities are analogous to land values in the agricultural context, and the risk of eviction plays a similar role, conceptually, in affecting decisions regarding investment in improved housing or farm capital. The impact of titled ownership on the supply of credit, however, may be more pronounced in the rural context and may cause variation in land prices even when the risk of eviction is small.

Thailand is an interesting case study on the value of secure ownership because bureaucratic constraints on titling in certain areas created a situation in which farmers with and without land documents operate side by side. This offers methodological advantages, because a cross-section study can provide insights that would otherwise require a more complicated time-series analysis. This article uses cross-section data on land prices in rural Thailand in order to estimate the value of ownership security. These estimates are used to evaluate the social benefits that may be expected to result from adoption of a policy granting secure legal ownership to squatters.

The structure of the article is as follows: section I presents background on land institutions in rural Thailand. It is followed by the presentation of the analytical framework and the formal model that underlie the empirical discussion in the subsequent section. Welfare implications and conclusions are presented in the last two sections.

I. Landownership Security in Thailand

Historically, all land in Thailand belonged, at least theoretically, to the king. Widespread forest clearing, settlement, and cultivation were tolerated, however, with few restrictions and little government control until fairly recent times.

The opening of the country to international trade and the increased commercialization of rice production in the second half of the nineteenth century generated a demand for well-defined land rights. Title documents for rice land were established in the main rice producing areas in the 1860s through the 1880s. Several modifications of the land law have been enacted since then, culminating in the Land Code of 1954.

The code defines two types of secure land documents: NS-4 and NS-3 (or NS3-K). The NS-4 document is a full and unrestricted legal title. The NS-3 or NS3-K documents are "certificates of utilization," which enable the owner to sell, transfer, and legally mortgage the land. They contain a demarcation of land boundaries, but they differ from the NS-4 in the accuracy of the demarcation. It is argued that there is little difference between full title and NS-3K or NS-3 and that "banks will lend equally, irrespective of whether the land has a title or a certificate of utilization" (Williamson 1983, 10). As the occurrence of full-title deeds (NS-4) is practically nil in our study areas, the NS-3 and NS-3K documents are classified as "titled land" in the analysis.

It is estimated that at least 5 million hectares (21 percent of land under private occupation in Thailand) officially classified as forest reserve land is actually under cultivation by squatters. Even though many of these squatters have had de facto possession of the land for ten to twenty years, they cannot obtain titles or certificates of utilization. All types of land (whether legally possessed or not) are freely traded despite the fact that some types are not legally transferable (Lin and Esposito 1976; Kemp 1981). It is simply beyond the capacity of the government to enforce the law.,

This study is based on samples of farmers from two different regions in Thailand, namely, the central (Lop Buri province) and northeast (Nakhon Ratchasima and Khon Kaen provinces). These regions were selected because they contain areas in which farmers with secure landownership (outside forest reserve) operate near farmers with insecure ownership (inside forest reserve). The plots of land in the forest reserve areas are untitled, whereas the plots located outside the forest reserves are mostly titled.

Titled and untitled farmers in the survey area stated that the most important benefit of having title is its use as collateral for loans. The next ranking benefit was the avoidance of eviction and the minimization of disputes (Chalamwong and Feder 1985). Given that the incidence of eviction from public agricultural land in Thailand in the past twenty-five years has been infrequent (see table 1), the data suggest that the main benefit of land documentation in the Thai

Table 1. *Sampled Farmers' Lifetime Experience with Eviction and Disputes, Thailand*
(percent)

	Province					
	Lop Buri		Nakhon Ratchasima		Khon Kaen	
Item	*Untitled farmers (N = 100)*	*Titled farmers (N = 84)*	*Untitled farmers (N = 89)*	*Titled farmers (N = 72)*	*Untitled farmers (N = 91)*	*Titled farmers (N = 93)*
Evictions	7.0	2.4[a]	9.0	1.4[a]	6.6	2.2[a]
Disputes	13.0	35.7	5.6	9.7	11.0	5.4
Land purchase	71.5	69.5	31.1	24.6	56.3	44.6
	(214)[b]	(211)	(279)	(247)	(189)	(258)

a. Eviction rates reported by titled farmers reflect normal expropriation with compensation for public projects such as roads and canals.
b. Figures in parentheses indicate the numbers of titled or untitled plots sampled.
Source: World Bank data.

context is derived from the improved access to credit. Econometric analysis shows that credit supply in Thailand is significantly affected by titled ownership and by the provision of land collateral (Feder and others 1986). The data also confirm that the land market is reasonably active both in and outside forest reserve areas (table 1, line 3). This background underlies the formal model of the determination of equilibrium land prices presented in the next section.

II. TENURE SECURITY, FARM PRODUCTIVITY, AND LAND VALUES: AN ANALYTICAL FRAMEWORK

Insecure ownership causes uncertainty regarding the land operator's ability to benefit from investments. Investment is expected to be negatively related to the level of uncertainty regarding tenure. A clear formal title backed by a legal system capable of enforcing property rights reduces or eliminates the uncertainty regarding tenure.

The role of secure legal title in providing farmers with access to cheaper, longer term, and more extensive credit is highlighted by many studies. Possession of land title is often a prerequisite for commercial or official bank loans that require collateral (Dorner and Saliba 1981, p. 23). A secure title may thus provide easy access to credit, especially from formal lenders who do not have personal and detailed information on the potential borrower. Interest rates in the formal sector are significantly lower than those in the informal sector.

It follows that ownership insecurity causes lower farm productivity due to lack of investment incentives and limited access to credit (Dorner and Saliba 1981). Empirical evidence directly linking secure titles to farm productivity is rather scant (Feder 1987). However, a recent study of the economic value of secured ownership in the context of urban housing using hedonic price analysis (Jimenez 1984) offers a plausible indirect approach: since the price of agricul-

tural land is related to its productive potential over a long time horizon, land values can be used to analyze the relation between ownership security and farm productivity and thus to provide estimates of private and social benefits of ownership security.

Although the assumptions of the model outlined below reflect circumstances in Thailand, they are also compatible with the situation in many other developing countries. Several simplifications are made for the sake of presentation, but most of these do not detract from the applicability of results to more general cases.

Assumptions

Land Market. (a) Land is of uniform quality but differs in its registration status. Untitled land cannot be transformed into titled land by the farmer. (b) All land can be bought and sold. (c) Land is divisible, but because of transportation considerations, a farmer can have either titled or untitled land, but not both.[1]

Credit Market. (a) Farmers can get credit only if they provide collateral. Farmers are credit-rationed.[2] (b) Interest rates are fixed. (c) The supply of credit is related to the value of titled land owned, which serves as collateral. (d) Credit can be used (together with initial wealth) to finance land purchase and investment in capital.[3]

Production. The production function exhibits constant returns to scale in land and capital.

Farmers. Farmers maximize their terminal wealth. They start with a given endowment of wealth and must choose whether to purchase titled or untitled land. Given their choice of type of land, farmers decide the amount of land to be purchased (which determines the value of investment in capital, given the constraint on credit).

Notation

Variables (subscripts t and nt stand for titled and nontitled farms, respectively): A_t, A_{nt} = amount of land; P_t, P_{nt} = price of land; K_t, K_{nt} = capital;

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1. This is a simplification. The sample underlying the present study shows that less than 20 percent of the farmers had both titled and untitled land. As the sample was deliberately taken in areas close to the boundaries between forest reserve and other land, the average incidence of mixed ownership is likely to be even lower.

2. The characterization of the credit market is based on the empirical analysis in Feder and others (1986). Most of the long- and medium-term loans observed in the sample were secured by land collateral. A disequilibrium econometric analysis of supply and demand for institutional credit established that a majority of the borrowers were credit-rationed. The institutional interest rate is fixed by law, whereas the variation in noninstitutional interest rates was small. The analysis demonstrated that land collateral and the value of land are important determinants of institutional credit, and the essence of this result is incorporated in the model.

3. Short-term credit is ignored in this model, as is the use of variable inputs. The extension of the model to include such elements does not alter the results (see Chalamwong and Feder 1985).

V_t, V_{nt} = terminal wealth; Y_t, Y_{nt} = output. *Note*: Lowercase letters denote values of variables per unit of land.

Parameters: s = credit per value of one unit of titled land; r = interest rate; W_0 = initial wealth.

Development of Model Results

Initially, it is assumed that improved access to credit is the only difference between titled and untitled land. In the subsequent section, the risk of eviction is added.

The optimization problem presented first is that of a farmer who chooses to purchase untitled land (prices of output and inputs are assumed as unity for convenience):

$$(1) \qquad \text{Max } V_{nt} = Y(A_{nt}, K_{nt}) + P_{nt} \cdot A_{nt}, A_{nt}$$

subject to the budget constraint (where no credit is allowed due to the absence of collateral-eligible land)

$$(2) \qquad P_{nt} \cdot A_{nt} + K_{nt} = W_0.$$

Employing the constant-returns-to-scale property of production, and substituting for K_{nt}, utilizing the budget constraint (equation 2), the objective function can be written as

$$(3) \qquad \underset{A_{nt}}{\text{Max }} V_{nt} = A_{nt} \cdot y\left[\left(\frac{W_0}{A_{nt}}\right) - P_{nt}\right] + A_{nt} \cdot P_{nt}.$$

The first-order condition for optimum is

$$(4) \qquad \frac{dV_{nt}}{dA_{nt}} = y_{nt} - \left(\frac{W_0}{A_{nt}}\right) \cdot y'_{nt} + P_{nt} = 0,$$

where $y' \equiv dy/dk$.

Using the first-order condition, one can verify that the demand for land is negatively related to its price, as intuition would suggest. It can also be shown that the optimal capital-land ratio is positively related to the price of land; as the price of land increases, capital becomes relatively cheaper and is substituted for land (see appendix). Multiplying equation 4 by A_{nt} and rearranging yields

$$(5) \qquad V^*_{nt} = A_{nt} \cdot (y_{nt} + P_{nt}) = W_0 \cdot y'_{nt},$$

where the asterisk denotes optimal value. The model thus implies that, at optimum, terminal wealth is equal to initial wealth times the marginal return to capital. A higher price of land reduces the terminal wealth, as less resources are available for capital formation (see appendix).

For the case in which the farmer decides to buy titled land, the objective function is

$$(6) \quad \underset{A_t}{\text{Max}} \; V_t = Y\,(A_t, K_t) + P_t \cdot A_t - (1 + r) \cdot s \cdot P_t \cdot A_t,$$

subject to the budget constraint (which incorporates the credit ration)

$$(7) \quad P_t \cdot A_t + K_t = W_0 + s \cdot P_t \cdot A_t.$$

Expressing production in per-unit-of-land-terms, and incorporating the budget constraint, yields the objective function

$$(8) \quad \underset{A_t}{\text{Max}} \; V_t = A_t \cdot y\left[\left(\frac{W_0}{A_t}\right) - (1 - s) \cdot P_t\right] + A_t \cdot P_t \cdot [1 - (1 + r) \cdot s].$$

Note that if $s = 0$ (that is, credit is unavailable), the objective function for a farmer buying titled land becomes identical to that of a farmer buying untitled land. The first-order condition for optimum is similar to equation 4:

$$(9) \quad \frac{dV_t}{dA_t} = y_t - \left(\frac{W_0}{A_t}\right) \cdot y_t' + \theta \cdot P_t = 0,$$

where $\theta \equiv [1 - (1 + r) \cdot s]$.

Multiplying equation 9 by A_t and rearranging yields

$$(10) \quad V_t = A_t \cdot (Y_t + \theta \cdot P_t) = W_0 \cdot y_t'.$$

By analogy to the case of untitled land, it can be verified that an increase in the price of titled land reduces the demand for titled land, increases the optimal capital-land ratio, and reduces the amount of terminal wealth. It can be further shown that optimal terminal wealth increases with the credit allocation parameter s, as the availability of more credit enables more investment and land acquisition.

In equilibrium, the value of terminal wealth for a farmer has to be identical whether he/she selects to buy titled or untitled land ($V_t^* = V_{nt}^*$); otherwise, one type of land will be preferred by all farmers. It is clear that the prices of the two types of land cannot be identical in equilibrium because with identical prices, the value of terminal wealth on titled land is higher due to the advantage in access to credit. The price of titled land is thus higher than the price of untitled land, equalizing the value of terminal wealth on the two types of land. An extension of this result is the hypothesis that when credit advantages due to the possession of title are small (s is small), the difference between the prices of titled and untitled land will be small (see appendix). Viewing s broadly as a parameter reflecting differential access to credit by titled and untitled farmers, one would expect s to be smaller in an area where most credit is provided by noninstitutional lenders. Such lenders are less inclined to require collateral, as they have alternative enforcement options, and therefore the difference between titled and untitled farmers' access to credit will be smaller.

The equilibrium concept referred to above (that is, equality of the optimized

terminal wealth) does not determine *unique* equilibrium prices, as there are infinitely many pairs (P_t, P_{nt}) satisfying $V_t^* = V_{nt}^*$. One simple way of "closing" the model is by considering a third investment opportunity, not related to land cultivation, with a fixed rate of return, say δ. In equilibrium it must hold, in view of equations 5 and 10, that

$$(11) \qquad W_0 \cdot (1 + \delta) = W_0 \cdot y_t' = W_0 \cdot y_{nt}'.$$

Given the monotonic negative relation between the optimal value of terminal wealth and land prices, there is a unique pair of equilibrium prices for titled and untitled land satisfying equation 11.

Introducing the Risk of Eviction

The model will now be expanded to incorporate the assumption that there is a nonzero probability (say, Ψ) that farms established on untitled land will lose a proportion, say $1 - \gamma$, of the land because of eviction. Because the model does not allow a distinction between periods before and after eviction, it is assumed that if eviction takes place, a proportion of $1 - \gamma$ of output is lost as well. For simplicity, risk-neutrality is assumed. However, results can be shown to hold with a mean–standard deviation objective function (Thomson and Hazell 1972). Farmers facing a risk of eviction are thus assumed to maximize the expected value of terminal wealth:

$$(12) \quad \begin{aligned} \text{Max } E(V_{nt}) &= (1 - \Psi) \cdot A_{nt} \cdot (y_{nt} + P_{nt}) + \Psi \cdot \gamma \cdot A_{nt} \cdot (y_{nt} + P_{nt}) \\ &= (1 - \Psi + \gamma \cdot \Psi) \cdot A_{nt} \cdot (y_{nt} + P_{nt}). \end{aligned}$$

The first-order condition for maximum of this modified equation is

$$(13) \qquad (1 - \Psi + \gamma \cdot \Psi) \cdot [y_{nt} - \left(\frac{W_0}{A_{nt}}\right) \cdot y_{nt}' + P_{nt}] = 0.$$

This condition is practically identical to equation 4, and all the comparative static results discussed earlier hold. However, utilization of equations 12 and 13 shows that equation 5 needs to be modified in the presence of risk, namely

$$(14) \qquad E(V_{nt}^*) = W_0 \cdot [1 - \Psi \cdot (1 - \gamma)] \cdot y_{nt}'.$$

In equilibrium, the value of the objective function for a farmer buying untitled land or titled land should be identical. Thus, when risk of eviction is present, the analog to equation 11 is

$$(15) \qquad y_t' = [1 - \Psi \cdot (1 - \gamma)] \cdot y_{nt}' = 1 + \delta.$$

It can be further shown that the equilibrium price of untitled land is negatively affected by the risk of eviction, as intuition would suggest.

The model thus generates the hypothesis that titled land will have a higher price than untitled land because of advantages in access to credit or a risk of eviction associated with untitled land, or both.

III. Empirical Results

In this section evidence is provided substantiating the hypothesis that titled land has a higher price than untitled land of equal quality. Land of lower productive quality (that is, poorer soil) or land located less favorably (that is, further away from the market) is expected to sell for a lower price, given the same title status. In order to test these hypotheses, data were collected on the value of farm land from a sample of landowners in 1984–85. The sample included both titled and untitled farmers (the latter mostly squatters in national forest reserve land) who were asked to assess the market value of their land, given its registration status and quality.[4]

The data provided by farmers on the value and physical attributes of each tract of land are utilized in a hedonic price analysis. The specification of hedonic price equations is typically arbitrary, and Box-Cox procedures are used to estimate a maximum likelihood nonlinear formulation (Jimenez 1984). However, the model of the preceding section can be utilized to generate a tractable hedonic price equation if a Cobb-Douglas specification is assumed for the production function. Denote

$$(16) \qquad Y = K^\alpha \cdot A^{1-\alpha} \cdot e^\mu,$$

where Y, K, and A were defined earlier, μ is a composite indicator of land quality, and α is a parameter.

It can be shown (see appendix) by utilizing equations 15, 13, and 9 that the equilibrium price of land can be written as

$$(17) \qquad \ln P = H_0 + H_1(s) + H_2(\Psi) + \frac{\mu}{(1 - \alpha)},$$

where H_1 and H_2 are positive constants such that $dH_1/ds > 0$, $dH_2/d\Psi < 0$. Suppose that μ is a linear combination of land quality indicators. Equation 17 can then be estimated straightforwardly, with a dummy variable for titled plots, representing the shift in the intercept due to the higher values of H_1 and H_2. The value of this title dummy variable thus represents both the security and credit effects of legal ownership.

A more refined hypothesis can also be tested using this approach. There are some holdings in the sample which are not titled but which are located outside the boundaries of the forest reserves. These tracts *can* be titled, and there is at present no risk of eviction to the owner. The perceived ownership security of these plots is therefore fairly similar to that of titled plots. However, in the absence of formal ownership documents, institutional lenders must treat the

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4. In the absence of specialized assessors in the rural areas of Thailand, there was no other way to obtain the current market value of land. Jimenez (1984) used data obtained in a similar manner for values of urban dwellings in legal and illegal settlements.

owners of such holdings the same as they do farmers with holdings in forest reserve areas (which are subject to a risk of eviction).

Technically, such plots are characterized by $\Psi = 0$ as well as $s = 0$. The constant term in the price equation for such plots is therefore smaller than that in the equation for titled plots, but it is larger than the constant term in the equation for untitled plots in the forest reserve. Put differently, the price of untitled plots *outside* the forest reserve is expected to be higher, other things being equal, than the price of untitled plots *in* the forest reserve, but lower than the price of titled plots. Because the price equations for the three types of plots differ only in the intercept, a single equation can be estimated, with dummy variables for titled plots and for untitled plots outside the forest reserve. The dependent variable is the natural logarithm of the price of a unit of land (expressed in local currency).

The sets of land characteristics that may affect productivity or farm gate prices (explanatory variables) are as follows:

Natural attributes: soil type (black, not black); slope (flat, not flat); low-land/upland; irrigation (year-round, seasonal)/rainfed; and suitability for sugarcane (only in Khon Kaen province).

Land improvements: bunds, land leveled by farm machinery, fruit trees on the land, and land cleared of stumps.

Location and transportation: all-weather road to the nearest market, time required to reach the nearest market (in minutes), all-weather road to the village, and time required to reach the village (in minutes).

Most of these variables affect the productive potential of the land or the cost of cultivation (for example, slope, bunds). Fruit trees provide an additional source of income. Favorable location increases the farm gate price of output or reduces the effective cost of inputs.

Estimation results are presented in table 2. It is clear that legal title is a significant factor in explaining the variation in land prices. In all three provinces, the parameter for the title dummy variable is significantly greater than zero at a 99 percent confidence level. There is a substantial difference in value of the parameter in Lop Buri province, where it is less than one-third of its value in the other two provinces. A possible explanation for this result is presented below.

As hypothesized, for all three provinces the parameter of the dummy variable for untitled plots outside the forest reserve is positive and significantly smaller (at a 95 percent confidence level) than the parameter of the dummy variable for titled land. It is significantly greater than zero in Nakhon Ratchasima and Khon Kaen provinces (at 94 and 95 percent confidence levels, respectively), implying that untitled land *outside* the forest reserve is more valuable than untitled land *in* the forest reserve, apparently because ownership of land outside the forest reserve is not challenged by the state and there is no risk of eviction. In Lop Buri province, there is no statistically significant difference in value between untitled land within and that outside the forest reserve, but the param-

Table 2. *Parameter Estimates from Hedonic Price Analysis, Thailand*

Variable	Lop Buri	Province Nakhon Ratchasima	Khon Kaen
Ownership security variables			
Title (D)[a]	0.2264 (5.48)[b]	0.8431 (14.29)	0.7605 (11.10)
Untitled out of forest reserve (D)	0.0516 (0.67)	0.1597 (1.63)	0.2018 (1.77)
Natural attributes			
Black soil (D)	0.0351 (0.55)	0.1855 (2.84)	0.0424 (0.51)
Flat slope (D)	0.0516 (0.90)	0.0102 (0.18)	0.1210 (1.66)
Lowland (D)	0.1722 (2.51)	−0.0304 (0.47)	0.1257 (1.70)
Year-round irrigation (D)	0.1398 (2.29)	0.2884 (2.60)	0.1112 (0.62)
Seasonal irrigation (D)	0.0865 (1.79)	0.2723 (4.30)	−0.0454 (0.25)
Suitability for sugarcane (D)	c	c	0.0450 (0.51)
Land improvements			
Bunds (D)	−0.0579 (1.21)	0.4148 (6.80)	0.2474 (3.48)
Leveling (D)	0.1030 (1.75)	−0.0122 (0.20)	−0.076 (0.93)
Fruit trees (D)	0.0649 (1.47)	−0.0082 (0.15)	0.0751 (1.17)
Cleared of stumps (D)	d	0.1226 (1.69)	0.0163 (0.22)
Location and transportation			
All-weather road to market (D)	d	0.1027 (1.32)	0.2122 (2.25)
Travel time to market	−0.1053 (3.62)	0.0395 (1.19)	0.0012 (0.027)
All-weather road to village (D)	0.0937 (2.39)	0.0924 (1.88)	−0.1005 (1.46)
Travel time to village	−0.0277 (1.57)	−0.0440 (1.67)	−0.0355 (1.14)
Constant	1.1910 (10.24)	0.5316 (2.78)	0.6659 (2.77)
R^2	0.183	0.578	0.389
F-value	7.165	47.410	17.090
Number of observations	431	536	447

a. (D) = Dummy variable.
b. Numbers in parentheses are Student "*t*" values.
c. Sugarcane not grown in the province.
d. Practically all observations have the same value for this variable.

eter for the latter type of land is about one fifth the parameter for titled land, a ratio almost identical to that observed in the other two provinces. Following the interpretation discussed above (see equation 17), the results suggest that the value of titled land attributable to security from eviction is only a small component (one fifth) of the total value of titled land, and that most of the value appears to derive from improved access to credit.[5]

The results for the other explanatory variables are mostly as anticipated: of 38 parameters estimated (for the three provinces combined), 29 have the expected sign, and none of those that have a counterintuitive sign is (statistically) significantly different from zero. Among the parameters with the expected sign, 17 are significant at a 95 percent (one-tailed) confidence level. The regression results imply that the value of equal-quality untitled land is 80, 43, and 47 percent of the value of titled land in Lop Buri, Nakhon Ratchasima, and Khon Kaen provinces, respectively.[6]

IV. SOCIAL BENEFITS OF TITLING

Having estimated the impact of titles on land prices, it is possible to calculate the social benefits of a policy granting titles to owners of untitled land. It is assumed that there is no environmental impact (that is, loss of forest land or game reserve), because, in the Thai context, the discussion deals with untitled lands that have been settled for many years but that are formally classified as "forest reserve lands." Presently, the law does not allow the granting of title on such lands. Given the suggestion above that access to credit is the main factor underlying the economic effects of land titles in Thailand, the realization of a significant impact from titling requires an increase in the overall supply of credit to agriculture. The calculation of the social benefits of titling assumes that policies to facilitate such an increase are enacted.

The calculation of the contribution to social welfare generated by a unit of untitled land requires a specification of the public benefit derived from lands from which squatters have been evicted. Assuming that such benefits are zero, equation 13 can be rearranged so that the left side represents *expected* social benefits

$$(18) \quad [1 - \Psi \cdot (1 - \gamma)] \cdot y_{nt} - k_{nt} \cdot (1 + \delta) = \delta \cdot P_{nt} + \Psi \cdot (1 - \gamma) \cdot P_{nt},$$

where use has been made of the equilibrium condition (equation 15) and the

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5. It could be argued that part of the difference in values between titled and untitled plots derives from avoidance of land disputes. However, the evidence presented in table 1 indicates that land disputes in untitled areas are not more frequent than in titled areas.

6. As a check for the robustness of the model, the approach utilized by Jimenez (1984) was replicated. That is, regression estimates were obtained separately for the subsamples of titled and untitled farmers, and parameter values were used to impute the land value in the other sample. The mean difference of the imputed and actual values is an estimate of the value of title. The estimates obtained in this manner are very close to those estimated directly in table 2.

budget constraint (equation 2). The left side of equation 18 represents the expected contribution to social welfare of one unit of land, net of the cost of resources consumed in the process of production. Real capital is evaluated in terms of its social opportunity cost $(1 + \delta)$. Denoting the left side of equation 18 by Π_{nt}, and using the opportunity rate of return to capital (δ) as a discount rate, the discounted value of the benefits derived from a unit of untitled land over an infinite horizon is

$$(19) \qquad \int_0^\infty e^{-\delta \cdot i} \cdot \Pi_{nt} \cdot di = P_{nt} \cdot \left[1 + \Psi \cdot \left(\frac{1 - \gamma}{\delta} \right) \right],$$

where i denotes time.

Equation 19 demonstrates a very plausible result, namely, that with a non-zero probability of eviction, the market price of untitled land underestimates the expected discounted value of social benefits forthcoming from such land.

By analogy to equation 18, the optimality condition for titled land (equation 10) can be used on the left side to express the social value of production (net of resource costs) generated in one period by a unit of titled land, that is, the net social benefit to society generated by such land:

$$(20) \qquad y_t - k_t \cdot (1 + \delta) = P_t \cdot [\delta - s \cdot (\delta - r)]$$

After denoting the left side of equation 20 by Π_t, the calculation of the discounted value of contributions to social welfare generated by a unit of titled land over an infinite horizon yields

$$(21) \qquad \int_0^\infty e^{-\delta \cdot i} \cdot \Pi_t \cdot di = P_t \cdot \left[1 - s \cdot \frac{(\delta - r)}{\delta} \right].$$

Equation 21 implies that when the opportunity cost of capital (δ) is higher than the prevailing interest rate (for example, when interest rate ceilings are imposed), the price of titled land is higher than its social value. This is due to the fact that the difference between the opportunity cost of capital and the interest rate is a subsidy accruing to owners of titled land. Although the subsidy is capitalized in the market value of titled land, it does not represent a real contribution to society.

The magnitude of the gross increase in social welfare resulting from allowing the legal registration of a unit of forest reserve land of given quality, expressed as a proportion (say, b) of the equilibrium price of untitled land of such quality, is obtained by calculating the ratio of the right sides of equation 21 and equation 19, minus one:

$$(23) \qquad b = \frac{P_t}{P_{nt}} \cdot \left\{ \frac{[\delta - s \cdot (\delta - r)]}{[\delta + \Psi \cdot (1 - \gamma)]} \right\} - 1$$

With a logarithmic specification of the hedonic price equation, the ratio P_t / P_{nt} is independent of land attributes, and is given by e^η, where η is the parameter

of land title in the logarithmic regression reported in table 2. The value of b for the three provinces can be calculated assuming alternative values of the opportunity cost of capital. Clearly, if there is no risk of eviction and if the credit market is not distorted, then the benefit can be calculated directly from the ratio of the prices of titled and untitled lands. When risk and distortion are present, the market prices need to be adjusted for benefit calculation. The probability of eviction can be taken as the differential in the rate of eviction between titled and untitled farmers as reported in table 1. Given that the government rarely confiscates complete holdings, and that farmers split holdings among family members to minimize the amount of land from which they are evicted, γ is assumed to take the value of 0.7. The parameter s is set at 0.1, which is the ratio of borrowing to land price observed in the sample. The nominal institutional interest rate in Thailand at the time of the study (1985) was 13 percent. However, the real interest rate (taking into account inflation) was about 8 percent. The estimates of social benefits reported in table 3 show significant benefit in the northeastern provinces but little benefit in Lop Buri province.[7] The social benefits are much smaller than the private benefits. The latter are given by $(P_t/P_{nt}) - 1$.

The calculation of social benefits assumes implicitly that formerly untitled farmers will receive the same amount of institutional credit that is currently available to titled farmers. Although credit markets are distorted, the present calculation considers the real opportunity cost of capital. The results imply that the gain in agricultural productivity due to titling accompanied by agricultural credit expansion outweighs the losses in other sectors of the economy (represented by the opportunity cost of capital). The magnitude of benefits in the northeast is much larger than the costs of registration and titling, which are estimated to be less than 5 percent of the value of untitled land (Burns 1985).

The reason for the small benefits to titling in Lop Buri (or the relatively small

Table 3. *Gross Social Benefits of Titling as a Proportion of the Price of Untitled Land, by Province of Thailand*

Opportunity cost of credit (δ)	Benefits (as proportion of P_{nt}) (b)		
	Lop Buri	Nakhon Ratchasima	Khon Kaen
0.10	0.059	0.854	0.852
0.12	0.063	0.888	0.863
0.14	0.072	0.913	0.871
0.16	0.078	0.932	0.877
Private benefit [$(P_t/P_{nt}) - 1$]	0.254	1.324	1.139

7. Alternative calculations were made with a model allowing for risk aversion, yielding smaller estimated benefits but similar ordering among provinces.

difference in the prices of titled and untitled lands) seems to lie in the structure of the credit market in that province, as the risk of eviction is not much lower than in other provinces. Analysis of credit transactions in the three provinces (Feder and others 1986) reveals that in Lop Buri farmers without titled land have access to substantial amounts of credit in the informal market through traders, who account for about 90 percent of informal loans and close to half of all credit. (In other provinces, traders are a negligible source of credit because of the much more limited extent of high-value cash crop cultivation.) Traders do not usually require land collateral in their credit transactions. It therefore follows that in Lop Buri farmers without land titles are subject to less significant disadvantages with respect to credit availability. Following the prediction of the model presented in section II, this implies that the prices of titled and untitled land will differ less in Lop Buri than in the other two provinces (recall that in the absence of credit constraints, prices will differ only according to the risk of eviction).

V. SUMMARY AND CONCLUSIONS

This article has presented an analysis of land prices in rural Thailand, focusing on the value of secure legal titles. The price of legally titled and documented land was shown to be significantly higher than the price of equal-quality land that is illegally held. The difference in land values is due mainly to the credit advantages accruing to owners of documented land and to a lesser extent to the risk of eviction, which is minor in Thailand.

A formal model of investment and production was constructed to provide an analytical framework for the empirical work and to facilitate an assessment of the impact of land-titling policy. It was shown that the divergence between the nominal cost of credit and the opportunity cost of capital will cause the equilibrium price of titled land to be higher than the social value of benefits generated by a unit of such land. The risk of eviction from untitled land will cause the market price of untitled land to be lower than the social value of benefits from such land. Formulas derived from the model were used to estimate the social benefits of releasing for de jure private ownership lands that are presently considered government property (these lands are de facto privately owned). It was shown that significant variation between benefits in different provinces is possible, but that benefits are substantial in provinces where the informal credit market is less developed.

The results estimated in this article suggest that national benefits would occur in Thailand from more intensive titling. The method developed in the article allows the ranking of different areas in terms of the benefits expected, which could be useful in determining priority for testing. In countries where ownership is more insecure than in Thailand, the effects would be even larger than those estimated in this article.

APPENDIX: MATHEMATICAL DERIVATION OF RESULTS

Differentiating equation 4 of the text yields

$$(A\text{-}1) \qquad -\left(\frac{W_0^2}{A_{nt}^3}\right) \cdot y_{nt}'' \cdot \left(\frac{dA_{nt}}{dP_{nt}}\right) = \left(\frac{W_0}{A_{nt}}\right) \cdot y_{nt}'' + 1 - y_{nt}'.$$

Applying the budget constraint (equation 2) in equation 4 yields

$$(A\text{-}2) \qquad (1 - y_{nt}') = -\frac{(y_{nt} - y_{nt}' \cdot k_{nt})}{P_{nt}}.$$

The right side of equation A-2 is negative, as $y > y' \cdot k$ due to the concavity of the production function. Concavity also implies that $y'' < 0$. It thus follows that $dA_{nt}/dP_{nt} < 0$; that is, the demand for land is negatively related to its price. To show that the optimal capital-land ratio is positively related to the price of land, note that by the budget constraint, $k_{nt} = (W_0/A_{nt}) - P_{nt}$. Thus

$$(A\text{-}3) \qquad \frac{dk_{nt}}{dP_{nt}} = -\left(\frac{W_0}{A_{nt}^2}\right) \cdot \left(\frac{dA_{nt}}{dP_{nt}}\right) - 1.$$

Using equation A-1 in equation A-3 yields

$$(A\text{-}4) \qquad \frac{dk_{nt}}{dP_{nt}} = \left[\frac{(1 - y_{nt}')}{y_{nt}''}\right] \cdot \left(\frac{A_{nt}}{W_0}\right) > 0.$$

Differentiating equation 5 of the text yields

$$(A\text{-}5) \qquad \frac{dV_{nt}^*}{dP_{nt}} = W_0 \cdot y_{nt}'' \cdot \left(\frac{dk_{nt}}{dP_{nt}}\right) < 0,$$

where the sign is verified using equation A-4.

For the case of titled land, the derivation of results parallel to those described above follows an analogous procedure. To show that terminal wealth increases with the credit parameter s, we first differentiate text equation 9 to obtain

$$(A\text{-}6) \qquad -\left(\frac{W_0^2}{A^3 A_{nt}}\right) \cdot y_t'' \cdot \left(\frac{dA_t}{ds}\right) = y_t' \cdot P_t - (1 + r) \cdot P_t - \left(\frac{W_0}{A_t}\right) \cdot P_t \cdot y_t''.$$

The assumption of a binding credit constraint implies $y_t' > (1 + r)$. Now, differentiating equation 10 yields

$$(A\text{-}7) \qquad \frac{dV_t^*}{ds} = W_0 \cdot y_t'' \cdot \left[P_t - \left(\frac{W_0}{A_t^2}\right) \cdot \left(\frac{dA_t}{ds}\right)\right].$$

Using equation A-6 in equation A-7 yields

$$(A\text{-}8) \qquad \frac{dV_t^*}{ds} = A_t \cdot P_t \cdot [y_t' - (1 + r)] > 0.$$

Consider the pairs of P_t, s that maintain a constant value of V_t^*. As $dV_t^*/dP_t < 0$ and $dV_t^*/ds > 0$, it is clear that the larger is s, the larger is the value of P_t which will maintain a fixed value of V_t^*. In equilibrium $V_{nt}^* = V_t^*$,

and given the value of V_{nt}^*, the difference between P_{nt} and P_t in equilibrium increases with s.

As is evident from equation 13, changes in the risk of eviction Ψ have no effect on the optimal k_{nt} when P_{nt} is given. Thus changes in the risk of eviction affect k_{nt} through the impact on the equilibrium price of untitled land P_{nt}. Differentiation of equation 15 yields

$$(A-9) \qquad [1 - \Psi \cdot (1 - \gamma)] \cdot y_{nt}'' \cdot \left(\frac{dk_{nt}}{dP_{nt}}\right) \cdot \left(\frac{dP_{nt}}{d\Psi}\right) = (1 - \gamma).$$

Earlier results established $dk_{nt}/dP_{nt} > 0$, and thus $dP_{nt}/d\Psi < 0$ for equation A-9 to be maintained. That is, the equilibrium price of untitled land is negatively affected by the risk of eviction.

To derive the econometric specification assuming the Cobb-Douglas function (equation 16), note that equation 15 implies

$$(A-10) \qquad R \cdot \alpha \cdot k_{nt}^{\alpha-1} \cdot e^{\mu} = 1 + \delta$$

where $R \equiv [1 - \Psi \cdot (1 - \gamma)]$. If $\Psi = 0$, then $R = 1$, and

$$(A-11) \qquad \alpha \cdot k_t^{\alpha-1} \cdot e^{\mu} = 1 + \delta.$$

Solving equations A-10 and A-11 for k_{nt} and k_t respectively, substituting for k_{nt} and k_t in the first-order conditions of equations 4 and 9 respectively, and solving for P_{nt} and P_t yields

$$(A-12) \qquad \begin{aligned} P_{nt} &= [(\alpha\,R)^{\alpha/(1-\alpha)} - (\alpha\,R)^{1/(1-\alpha)}] \cdot \\ &\quad (1 + \delta)^{-\alpha/(1-\alpha)} \cdot \delta^{-1} \cdot e^{\mu/(1-\alpha)} \end{aligned}$$

$$(A-13) \qquad \begin{aligned} P_t &= [\alpha^{\alpha/(1-\alpha)} - \alpha^{1/(1-\alpha)}] \cdot (1 + \delta)^{-\alpha/(1-\alpha)} \cdot \\ &\quad [\delta + s \cdot (r - \delta)]^{-1} \cdot e^{\mu/(1-\alpha)}. \end{aligned}$$

Denote

$$H_0 \equiv -\left[\frac{\alpha}{(1-\alpha)}\right] \cdot \ln(1 + \delta)$$

$$H_1(s) \equiv -\ln[\delta + s(r - \delta)]; \quad \frac{dH_1}{ds} > 0$$

$$H_2(\Psi) \equiv \ln[(\alpha\,R)^{\alpha/(1-\alpha)} - (\alpha\,R)^{1/(1-\alpha)}]; \quad \frac{dH_2}{d\Psi} < 0.$$

Note that $H_1(0) = -\ln\delta$, and $H_2(0) = \ln[\alpha^{\alpha/(1-\alpha)} - \alpha^{1/(1-\alpha)}]$.

Inspection of equations A-12 and A-13 shows that the (logarithmic) price equation can be written in general as

$$(A-14) \qquad \ln P = H_0 + H_1(s) + H_2(\Psi) + \frac{\mu}{(1-\alpha)}.$$

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