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TENURE SECURITY FOR WHOM?
DIFFERENTIAL IMPACTS OF LAND POLICY IN KENYA

by

Michael R. Carter, Keith D. Wiebe, and Benoit Blarel

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CONTENTS

FIGURES AND TABLES

PREFACE AND ACKNOWLEDGMENTS

This study in part of the Land Tenure Center's comparative program of research on security of tenure and land registration initiatives in Africa. This four year research program has been carried out under LTC's Cooperative Agreement (ACCESS I) with AID's Bureau of Science and Technology and has involved a year or more of fieldwork in Somalia, Senegal, Uganda, and Kenya, short-term work in other countries, and an extensive literature review. It has sought to understand, through study of a number of titling initiatives, the actual impacts of such programs. It is in the light of this experience that future proposals for titling programs must be evaluated rather than solely in terms of a potential indicated by theory. Experience in the end suggests modifications to our theoretical models, more rigorous statement of their assumptions and an understanding of how far these assumptions apply in the cases which concern us.

The planning and fieldwork for the study was funded under the Program Support Grant by AID's Bureau of Science and Technology to the University of Wisconsin's College of Agricultural and Life Sciences. It was implemented under its Memorandum of Understanding with Virginia State University in connection with Virginia State's longstanding involvement with Egerton University College, Njoro. The research on tenure was part of a comprehensive study of the economics of smallholder agriculture in the region. The Land Tenure Center utilized Africa Bureau Strategic Studies funds under its Security of Tenure and Land Registration Project to meet the costs of data analysis and write-up for this portion of the research. The Land Tenure Center appreciates the interest and support of many in AID/Washington, including David Atwood and Gloria Steele in the Bureau of Science and Technology; Pat Fleuret, Gerald Cashin, and Curt Reintsma in Africa Bureau; and Joan Atherton in PPC.

The authors wish to express their thanks to Edwin Ireri, George Gichuhi, Bernard Kitur, and Christopher Onyango of Egerton's faculty for help in the supervision of data collection; Messrs. Kangethe, Asira, Nduati, and other students at Egerton for assistance in data collection; Nereah Kilongosi and David Olieba for patience in computer data entry; and John Bruce (LTC), Shem Migot-Adholla (World Bank), and Carol Dickerman (LTC) for comments on an earlier draft.

John W. Bruce, Project Coordinator
Security of Tenure/Land Registration

EXECUTIVE SUMMARY

The perception that existing land tenure patterns inhibit agricultural productivity in parts of sub-Saharan Africa has incited interest in programs to provide farmers with registered titles to their land. The standard argument for tenure reform centers on the role of uncertainty in discouraging investment on land which is held without long-term security. Land title which enhances such security may induce investment and productivity increases both from the **demand** side, as farmers become more certain of reaping investment's benefits in the future, and from the **supply** side, by affording farmers better access to credit.

Tenure reform does not, of course, operate in a vacuum--other factors constrain agricultural performance, and may overwhelm the effects of enhanced tenure security. Specifically, in a world where access to markets is imperfect, both demand and supply effects may be limited to those farmers who are already well-endowed with agricultural resources and access to markets. As a result, tenure reform policies may have very different effects on different classes of farmers. An important question is raised: "**For whom** does enhanced tenure security bring productivity gains?"

An important methodological point must also be considered. When title acquisition is costly, identification and measurement of the impact of tenure reform is complicated because the best-endowed farmers, most likely to benefit from enhanced tenure security, are also most likely to seek title to their land. Farmers less favorably endowed are in turn less likely to do so. Simple comparison of the performance of observed titled and untitled farms thus tends to overstate both the realized impact of title on farmers who have obtained it and the potential impact of title on those who have not.

Kenya is one country that has had considerable experience with land registration and titling programs--both prior and subsequent to independence. As such, Kenya affords a valuable opportunity to consider these issues. A simple comparison of smallholders in Njoro Division suggests that titled farms are indeed more productive than are farms without title. Demand side effects of enhanced tenure security are found to be absent, however, suggesting that credit supply may impose tighter constraints on investment and productivity than do farmers' perceptions of insecurity. The apparent superiority of titled farms is in fact driven by a spurious correlation between market access and title status; potential effects of title are overwhelmed by differences in cropping patterns and technology choice due to differential access to land, labor, capital, and insurance.

Efforts to enhance smallholder productivity via land tenure reform alone are thus likely to meet with limited success: title status appears to be less important in the determination of farm productivity than are other factors such as market access. Furthermore, in light of the link between these other factors and farmers' endowments of land and other resources, tenure reform's distributional effects may prove as worthy of attention as are its potential efficiency consequences.

Tenure Security for Whom?
Differential Impacts of Land Policy in Kenya

by

Michael R. Carter, Keith D. Wiebe, and Benoit Blarel*

The perception that existing land tenure patterns inhibit agricultural productivity and growth in areas of sub-Saharan Africa has incited interest in programs to provide individuals with registered titles to their agricultural land. Tenure reform, by enhancing individual ownership security, is expected to increase agricultural investment and improve the performance of the agricultural sector. A pioneering study of Thailand by Feder et al. (1988) suggests that these expectations, while clearly ambitious, are entirely reasonable.

Land registration and titling programs are not new in sub-Saharan Africa. Tenure reform carried out under the Swynnerton plan in Kenya in the 1950s gives that country claim to substantial experience with such programs. Perhaps more importantly, Kenya exhibits significant land scarcity; thus the economic value of land, and consequently the potential returns to land titling programs, should be relatively high.

Using a cross-sectional farm-level data set from Kenya's highly commercialized Njoro area, this paper analyzes the impact of tenure status on agricultural productivity. The goals of this analysis are twofold. First, this paper tries to lay out in a clear and general way the problems which hamper easy identification and measurement of the impact of tenure reforms. It should be stressed at the outset that these problems are <u>not</u> substantively uninteresting methodological artifacts. They are rooted in the economic behavior and market structure which ultimately shape the impact of land tenure reform. A clear statement and understanding of these problems should be of general interest and value for land titling program design and research. In addition, integrating the analysis of land titling with consideration of market structure and other factors which influence title's effects helps shed light on the controversy over whether such programs prompt land concentration over the longer term. Applying lessons derived from this first exercise, the paper's second goal is to evaluate the productivity effects of those tenure patterns which have resulted from Kenya's particular experiences with land titling efforts.

This paper is organized as follows: section 1 uses descriptive statistics from the Njoro data set to describe the range of factors which temper the impact of tenure status on productivity and may hamper the identification of tenure reform program effects. Section 2 performs a series of preliminary or "naive" analyses of the Njoro data. Criticism of these analyses structures presentation of general theoretical concerns about the way tenure security influences agricultural performance. Section 3 substantiates the empirical relevance of these theoretical concerns by demonstrating the importance of nontenure factors on agricultural performance. Section 4 then presents a unified analysis of the land title issue. Finally, in section 5,

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we conclude that land tenure reform will likely prove ineffective if conducted in a vacuum: title status appears to be less important in the determination of farm productivity than do factors such as farm size and mode of access to land, together with their implications for access to markets, nonfarm income, and wealth.

1. Agriculture in Njoro: Farm Size, Factor Markets, and Access to Land

The Njoro study area is located about 200 kilometers northwest of Nairobi in Kenya's Rift Valley. Despite its location on the equator, an altitude of about 2,000 meters gives the area a subtropical climate. Rainfall averages about 1,000 millimeters annually, concentrated in the "long rains" of March-May and the "short rains" of July-August (Kenya 1983). Maize, beans, wheat, and a variety of garden crops are grown. Pasture and forage crops support a sizable dairy industry.

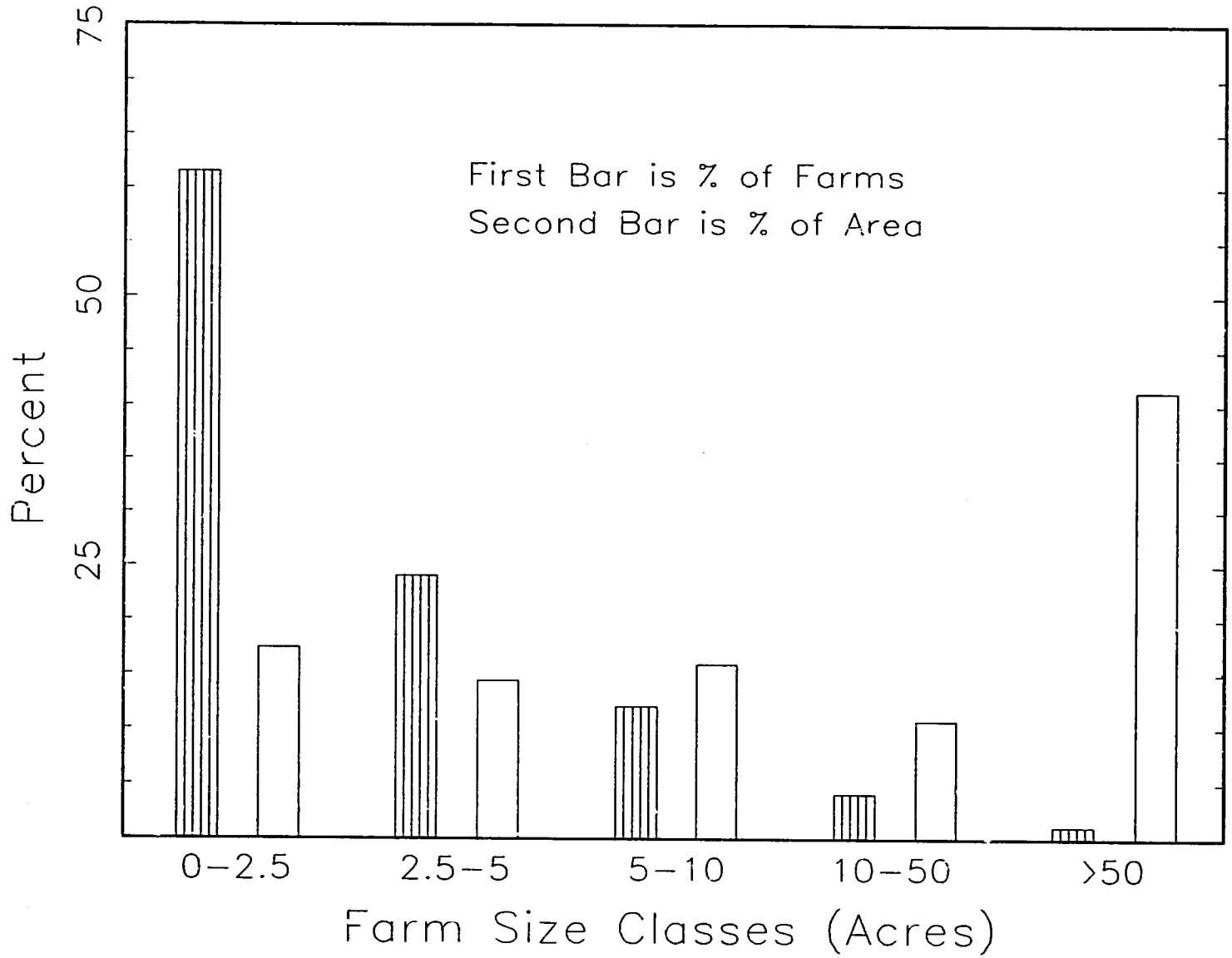
During the colonial period, Njoro was a "Scheduled Area," and agriculture was restricted to white settlers. Land was divided between large-scale farms, ranches, and, in the upper zone, forest. Following independence it was felt, for both economic and political reasons, that the large-scale structure of farming in the Scheduled Areas should be left intact. The large-scale sector was perceived as an important source of foreign exchange earnings and a net supplier of food to urban areas. Intact transfer of the large farms to Africans took place through purchases either by private individuals or by land purchase companies or cooperatives.

Some immediate redistribution and resettlement of small-scale individual farms did take place within the large-scale agricultural and forest reserves of the Scheduled Areas. Yeoman schemes, the Million Acres Scheme, and squatter settlement schemes were among the programs implemented for these purposes, the latter two being managed by the Settlement Fund Trustees (SFT) (see, for example, Leo 1978). On a national level, the three schemes transferred to Africans 17 percent of all land originally held by European settlers (Okoth-Ogendo 1981).

Njoro today contains almost the full range of the processes through which land has been transferred since independence. Large farms were bought intact by the SFT and redistributed to the landless. A Squatter Settlement Scheme opened up what was previously a forest reserve and also distributed portions of European farms to squatters. Through these various schemes, a new small-scale farming sector emerged as individuals were allocated parcels ranging from 5 to 10 acres in size. In addition, those large-scale units which were purchased intact by land-buying companies (LBCs) and farmed initially as single units were also quickly (and unofficially) subdivided among the share members. This *de facto* subdivision was ultimately ratified by the government in its Fourth Development Plan for 1979 to 1983. By 1986, more than a third of Njoro's large farms had been subdivided by one mechanism or another; resulting farms today vary, both within and between ex-large farms, from less than 1 acre to more than 20 acres in size.

With resettlement and subdivision, Njoro Division's population density has climbed to 193 persons per square kilometer (Kenya 1979) while average landholdings have decreased to about 5 acres per household (Kenya 1977). Yet, as figure 1 reveals, landownership in Njoro remains markedly concentrated. The stratum of largest farms (those greater than 50 acres in size) comprises less than 1 percent of ownership units but controls approximately 40 percent of agricultural area. In addition, land controlled by the large-farm sector is generally of better quality, characterized by flatter terrain and better served with feeder roads, water, and electricity. Subdivided ex-large farms--and to an even greater extent settlement schemes--are hillier, are characterized by poorer soils, and are often poorly connected with roads and water supplies. The sample of farms analyzed in this study was drawn exclusively from the Njoro small-farm sector created through postindependence settlement

Figure 1: Njoro Farm Size Distribution



and subdivision processes. (Appendix A details the sampling methodology.) Table 1 displays size, tenure, and "mode of access" characteristics of the sample. The 109 sampled farms average 9.5 acres, ranging from just under 1 acre to more than 80 acres in size. Labor and capital access are likely to differ substantially over such a range, with farms facing different effective prices and exhibiting distinctive economic behavior and productivity patterns. For example, maize yields averaged 782 kilograms per acre on farms of 3-5 acres but more than twice that on farms larger than 20 acres.

Table 1 also distinguishes farm characteristics by mode of access--whether the farm was established through an SFT settlement scheme, via the subdivision of a large-scale farm purchased by a land-buying company, or through rental or borrowing arrangements. Only five farms surveyed had been transferred (through sales) since their establishment as part of the original subdivision process; these are incorporated in the table on the basis of their original status. The sample included no transfers by inheritance.

Mode of access is a potentially significant factor because the wealth and other characteristics of land-buying company shareholders, who acquired land commercially, are likely to be quite different from those of participants in settlement schemes, who acquired land at concessional terms on the basis of need. Collier and Lal (1986) have argued forcefully that access to nonagricultural income and wealth carries special significance in Kenyan agriculture, where factor (especially capital) markets are highly imperfect. As with farm size, mode of access to land is thus likely to signal the presence of other factors which may shape farm productivity and which may be related to and condition the impact of tenure security. SFT farms generated maize yields averaging 873 kilograms per acre, for example, while LBC farms were 50 percent more productive.

Table 1 also distinguishes farms on the basis of tenure arrangements. All land in the study area is titled. Because of the different institutional environments under which subdivision and resettlement have taken place, however, not all farmers have yet been granted individual title to their land. On some SFT settlement schemes, individual land titles have been withheld pending repayment of land purchase loans. Problems of demarcation, allowance for public roads, and, more importantly, sales of excess shares by some land-buying company managers have hampered the titling process as well. **A farm is considered titled if and only if title has been issued for the parcel of land established in the original subdivision process.** (Appendix A describes this parcel in detail.) Additional fields acquired subsequent to that process may also be titled or untitled. Sampled farms include some which are held with title, some which are held without title, and some which are composed primarily of land which has been rented or borrowed. While titled farms produced 1,125 kilograms of maize per acre, untitled farms produced about 20 percent less.

It is the behavior of producers in these different tenure categories which this study will examine in its effort to identify the economic impact of security offered by individual land title and to assess thereby the value of titling and registration programs. It is important to note at this stage that such programs are highly controversial. Coldham (1979) and Haugerud (1983), for example, note the widespread persistence of some customary tenure patterns despite efforts at formal registration. Conversely, Barrows and Roth (1989) and Shipton (1989) observe the emergence of individualized property rights in the context of population pressure even when formal registration efforts are absent. Okoth-Ogendo (1982) argues that title provision is neither necessary nor sufficient to enhance the supply of credit to smallholders, and Odingo (1982) makes a similar point with respect to credit demand.

Table 1. Size, Tenure, and Mode of Access Characteristics (acreage)

Tenure/Access	<3	3-5	5-10	10-20	>20	All
All						
# farms	18	32	31	18	10	109
Average size	2.1	4.2	7.8	15.1	35.3	9.5
Maize (kg/A)	1046.2	782.5	946.4	1102.4	1756.0	1053.0
Mode of Access						
SFT*						
# farms	3	25	25	4	0	57
Average size	2.7	4.2	7.9	10.4	--	6.2
Maize (kg/A)	991.7	750.4	905.3	1029.7	--	873.0
LBC*						
# farms	10	5	5	13	10	43
Average size	1.9	4.2	7.3	16.9	35.3	15.1
Maize (kg/A)	1175.2	1172.3	1079.4	1170.8	1756.0	1332.0
Rented/Borrowed						
# farms	5	2	1	1	0	9
Average size	2.1	4.3	5.9	10.2	--	3.9
Maize (kg/A)	879.3	399.7	1281.1	677.6	--	776.2
Tenure						
Title						
# farms	2	10	26	16	10	64
average size	2.7	4.4	7.9	15.6	35.3	13.4
maize (kg/A)	954.3	771.8	916.8	1181.7	1756.0	1125.4
No Title						
# farms	11	20	4	1	0	36
average size	1.9	4.1	7.5	11.1	--	4.0
maize (kg/A)	1160.0	837.7	1033.1	663.8	--	912.9
Rented/Borrowed						
# farms	5	2	1	1	0	9
average size	2.1	4.3	5.9	10.2	--	3.9
maize (kg/A)	879.3	399.7	1281.1	677.6	--	776.2

* SFT = farms established through Settlement Fund Trustees schemes; LBC = farms established via land-buying companies.

Another frequent criticism of individual land registration and titling is its potential for increasing land distribution inequality (Njeru 1978; Okoth-Ogendo 1982; World Bank 1983; Shipton 1988). Although there is little evidence with which to evaluate this criticism, land concentration was an integral part of the objectives set forth by the Swynnerton Plan in Kenya in 1954:

> In the past Government policy has been to maintain the tribal system of tenure so that all the people have had bits of land and to protect the African from borrowing against the security of his land . . . . In future, if these recommendations are accepted, former Government policy will be reversed to enable energetic or rich Africans to acquire more land and bad or poor farmers less, creating a landed and a landless class. This is a normal step in the evolution of a country (Swynnerton 1954, p. 10).[1]

Specifically, Swynnerton expected land concentration to result from individualization of tenure and the spread of market forces within the relatively egalitarian customary sector. In Njoro, where the processes of subdivision and resettlement have created a structure of market-oriented holdings already characterized by individual tenure and marked inequality, one might expect such dynamics to operate even more strongly.

In the context of contemporary realities, Swynnerton's "normal" step is of dubious desirability. Limitations on Kenya's supply of good agricultural land (18 percent of its total land area) and on opportunities outside agriculture combine with high population growth rates (3.9 percent annually) to raise serious doubts about the suitability of land concentration as an engine for growth. While thorough evaluation of the longer-term effects of titling programs on land concentration is beyond this study's focus on productivity, attention to the conditioning effects of farm size, market access, and wealth also helps shed light on this important issue.

2. Identifying the Economic Impacts of Tenure Security Programs: Theoretical Considerations and Empirical Complications

This section develops a simple but general model of farmer decision-making and the impact of individual land title on agricultural productivity. After illustrating the standard economic case for land titling, the framework provides the basis for a critique of an effort to identify the impact of title from a simple analysis of the Njoro data. The critique considers two specific identification problems:

(1) the identification of title effects separate from the effects of mediating factors that may be related to title status; and,

(2) the identification of credit supply-induced effects versus security or demand-induced effects.

Consideration of the first identification problem (or, more precisely, of the economics that create it) permits clarification of the criticism of land titling programs summarized in section 1.

2.1 A Model of Title, Tenure Security, and Productivity

Consider the following simple present-value model of returns to investment in agriculture:

$$E(PV_{ik}) = \Sigma_t \{[1-\phi_{ik}(T_k)]\pi_{ikt}(\bar{M})\}/\{1+r(\bar{T},\bar{M})\}^t , \quad (1)$$

where the expected present value of return to investment project "i" on field "k" is the weighted, discounted sum of the yearly net income, "π_{ikt}," generated by the investment in each year "t" of its duration. "ϕ_{ik}" is the probability that the farmer is evicted from field k in year t, and is a function of the tenure status T_k of that field. **(It is held as a maintained hypothesis in this analysis that reduced legal exposure to eviction does imply a reduced subjective perception of the probability of eviction on the part of farmers.** Such a relationship is, of course, a matter for empirical investigation and will be analyzed formally with regard to demand-induced effects of title in sections 2.4 and 4.2.) In equation (1), annual net income is thus weighted by the probability, $[1-\phi_{ik}]$, that the farmer will actually realize the returns from investment on field k. The term "$r(\bar{T},\bar{M})$" is the farmer's discount rate, assumed here to be the shadow price of capital on the farm. The variables "$\bar{M}$" and "$\bar{T}$" are farm-level variables which measure market access and aggregate tenure status, respectively. $\bar{T}$ can in turn be considered an appropriately weighted average of the T_k's which describe the different fields comprising the farm:

$$\bar{T} = \Sigma_k w_k T_k , \quad (2)$$

where the weights w_k might be based, for example, on the collateral value of particular fields.

Investment ik is assumed to be undertaken if

$$E(PV_{ik}) > C_i^* , \quad (3)$$

where C_i^* measures the immediate direct costs of the project. Holding the farm's discount rate and market access fixed, the number of investment projects undertaken can be expressed as a function of the eviction probability as shown in figure 2.[2] As the eviction probability decreases, the expected present value of a given net income stream increases, and more investment projects become worthwhile. A shift in tenure status T_k for field k, say through acquisition of a secure title, will reduce the farmer's legal exposure to eviction. If, as a result, the perceived probability of eviction decreases, the tenure shift will generate increased investment. The greater investment by the more secure titled landholders would be reflected over time in superior agricultural performance and would be visible as higher yields and net returns.

2.2 A "Naive" Statistical Analysis of the Impact of Title in Njoro

A total of 100 farms in the sample are owned, 64 of them with title. The remaining 9 farms are operated under other tenure patterns, namely, rental and land borrowing arrangements. Table 2 presents a profile of agricultural activities on the basis of farms' title status. Mean values of inputs, outputs, and net returns from principal agricultural activities are summarized from biweekly survey data along with several measures of land allocation and crop yields. Values of all inputs and outputs, including labor, are imputed at sample average prices reported for inputs purchased and outputs sold.

Figure 2: Investment and Eviction Probability

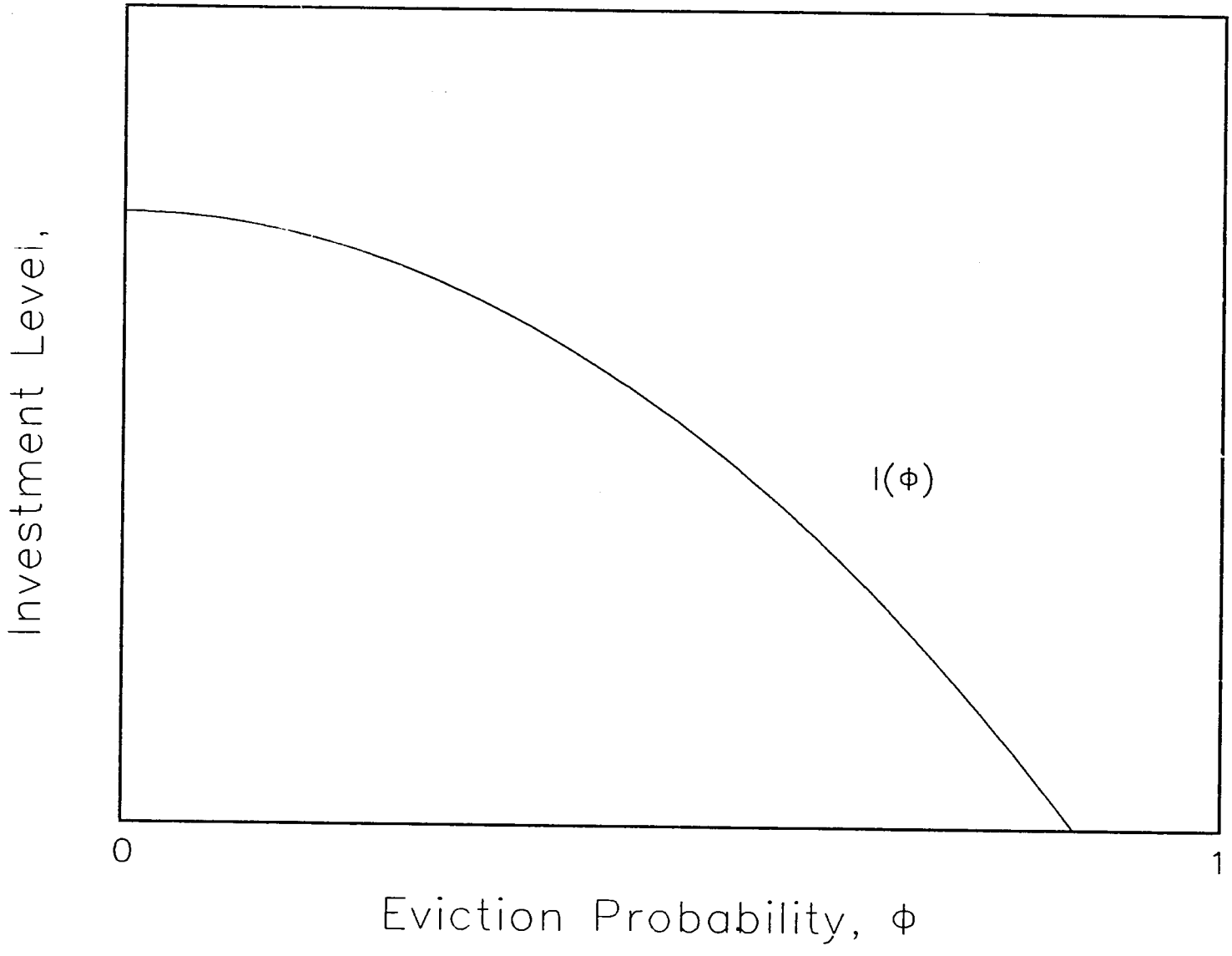


Table 2. Value of Inputs and Outputs on Maize-Beans, Wheat, and Livestock Activities by Farm Tenure Status (Ksh per farm acre unless otherwise indicated)*

	Title	No Title	Other	All
Number of farms	64	36	9	109
Farm size (acres)	13.40	4.00	3.94	9.51
% land in maize	37.92	76.59	82.47	44.82
% land in wheat	20.26	0.00	0.00	16.75
Maize yield (kg/acre)	1125.37	912.89	776.15	1052.96
Wheat yield (kg/acre)	1269.58	--	--	1269.58
Inputs	**1277.86**	**2701.02**	**2445.65**	**1515.51**
Nonlabor	**418.58**	**438.97**	**493.22**	**423.95**
Seeds	142.91	171.85	162.82	147.62
Manure	0.42	11.36	2.26	2.00
Fertilizer	78.26	24.68	13.58	68.60
Chemicals	11.94	5.24	2.15	10.68
Livestock	177.64	211.42	299.63	186.50
Other	7.41	14.42	12.78	8.55
Family Labor**	**560.10**	**1495.05**	**1071.90**	**707.51**
Male	204.14	656.16	336.77	271.49
Female	266.56	623.97	667.15	329.91
Child	89.40	214.92	67.98	106.11
Hired Labor	**165.28**	**696.65**	**834.23**	**261.97**
Casual	85.71	274.26	287.08	118.79
Regular	79.57	422.39	547.15	143.18
Machine services	**130.90**	**70.35**	**46.30**	**122.08**
Outputs	**2671.55**	**2941.99**	**2310.49**	**2696.79**
Maize-Beans	1056.93	1951.30	1641.28	1201.17
Wheat	845.36	0.00	0.00	699.01
Livestock	769.26	990.69	669.21	796.61
Net returns				
Family income	**1953.79**	**1736.02**	**936.74**	**1888.79**
Profits	**1393.69**	**240.97**	**-135.16**	**1181.28**

* In 1986, the exchange rate between Kenya shillings and US dollars was about 16:1.

** In adult equivalent units: male = 1.00, female = 1.00, child = 0.50.

Titled farms can be immediately distinguished from untitled and other farms on the basis of size and cropping patterns. Titled farms are substantially larger on average than are all other farms and allocate significantly less (in percentage terms) of their agricultural land to maize and bean cultivation. Maize yields differ significantly by title status, with titled farms averaging over 210 kilograms per acre more than untitled farms--a gain in productivity of about 23 percent. Wheat production within the sample is found exclusively on titled farms. These findings provide some initial support for a link between title status and productivity.

In order to determine the existence of a relationship between title and investment, however, such a link must be traced back to farmers' resource allocation decisions. Surprisingly, input levels are highest on farms without title. The total value of inputs on titled farms averages less than half of that on farms operated without title or under other arrangements. Differences in input levels arise primarily from differences in labor application, which constitutes over half of the value of total inputs per farm acre. Untitled farms report nearly three times the family labor applied on titled farms, for example, and nearly half again as much as that applied under other tenure arrangements. (Family labor is here valued at average market wages paid to casual labor for the various agricultural activities.) The differences in labor application are related to clear differences between titled and untitled farms in average farm size and in patterns of land allocation to maize and wheat. These differences are discussed further in section 3 below.

In contrast to the general pattern of input application, fertilizer and chemical input levels are highest on titled farms. This lends support to the hypothesis that tenure security in the form of a title provides an incentive for investment in the maintenance of soil fertility.

Outputs show less variation in absolute levels but are markedly different in terms of composition. Specifically, wheat production generates almost one-third of the average value of gross output on farms with title but does not contribute at all to the output of untitled and other farms.

Finally, two measures of net returns also vary with title status. Family income represents the per-acre value of returns to agricultural activities when the value of all inputs **besides** family labor has been subtracted from gross output. Profits measure the difference between gross output and the value of all inputs **including** family labor. (In effect, the family-income measure imputes a value of zero to family labor, while "profits" value family labor at the market wage. The true value of family labor, and thus of net returns to agricultural activities, lies somewhere between the two.)

Family income, at just under KSh 2,000 per acre, is not significantly higher on titled farms than it is on farms owned without title (because, as noted, differences in input levels consist largely of differences in family labor application, which is not included in this first measure of net returns). Rented and borrowed farms generate family income levels averaging under KSh 1,000 per acre, significantly less than on owned farms with or without title.

Lower input costs in the form of family labor compensate for lower output levels on titled farms, which thus earn sharply higher profits (over KSh 1,000 per acre more) than do untitled farms. Negative profits imputed for other farms reflect the fact that market wages, at which all labor is valued, almost certainly overstate the actual opportunity cost of family labor applied to own production.

Overall, Table 2 offers only mixed support for the general hypothesis that tenure security in the form of a title induces farmers to apply inputs more intensively and generate greater levels of output and net returns per acre. Tenure security may indeed provide such incentives, but these appear to be confounded by other factors which have not yet been formally incorporated. Two sets of issues in particular need to be addressed. First, factors other than title--farm size, mode of access, and farmer characteristics, for example--also affect resource allocation and productivity. And second, tenure security-related demand incentives may be constrained by supply-side restrictions, for example, as in the provision of smallholder credit. These issues are examined in subsequent sections.

2.3 Identification Problem 1: Title Effects versus the Mediating Impact of Market Access and other Farm Characteristics

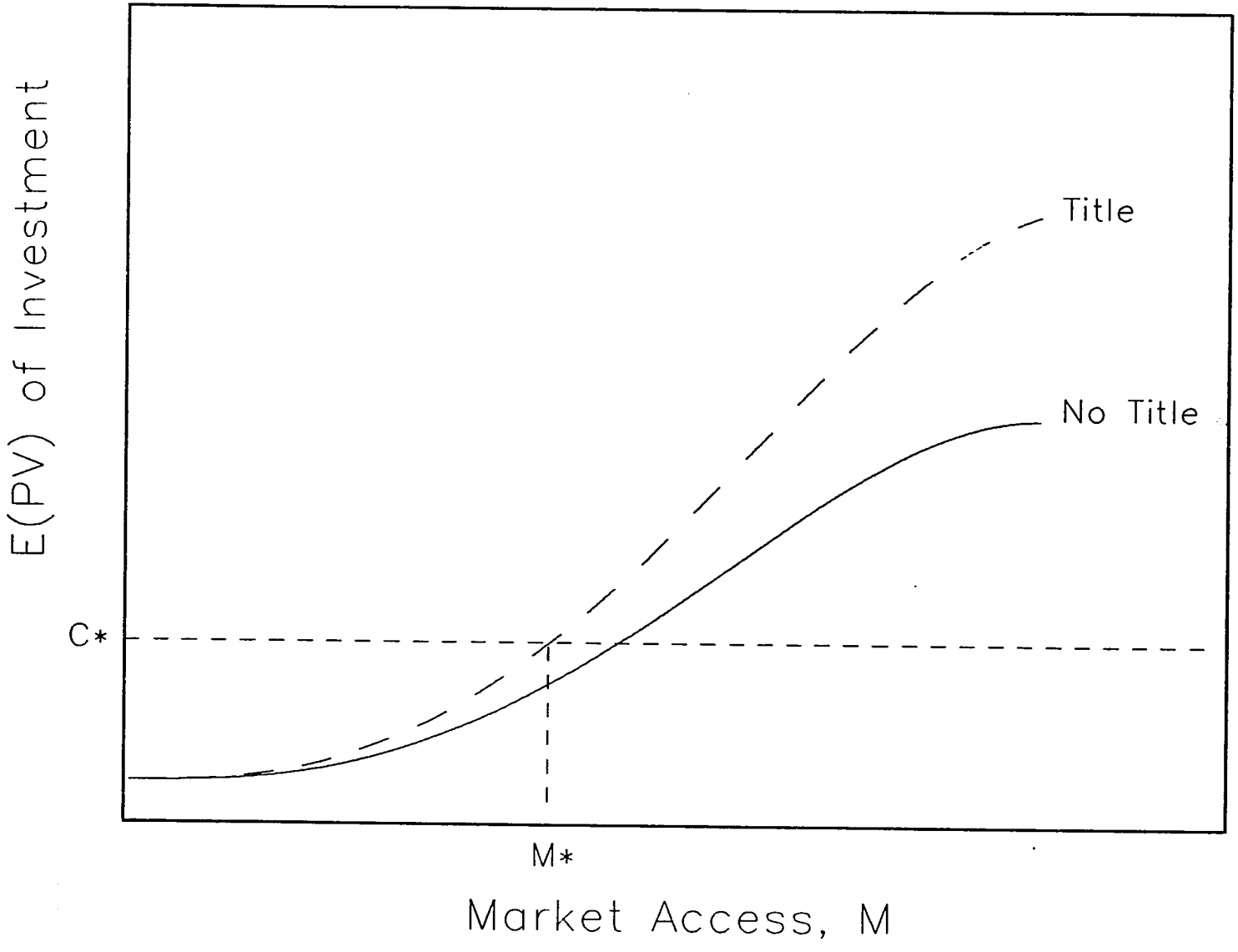
The analysis to this point has examined the impact of land title on economic performance without consideration of the impact (and confounding effects) of other factors that affect farm decision-making and productivity. While this approach simplifies presentation of some of the basic issues in land titling, it is not a trustworthy basis for inference about the impact land titles may actually have. Further exploiting the simple model introduced in section 2.1, this section argues that in general one would expect observed title status to be systematically related to other factors which influence farm productivity. The impact of title per se cannot be identified without explicitly taking these other factors into account. In addition, consideration of these factors suggests another question: "For what kind of farmer do we wish to measure the impact of land title?" The fact that such a question may indeed be relevant--that some farmers may benefit from enhanced tenure security while others may not--underlies the criticism that titling programs may drive rural inequality and differentiation.

The analysis in section 2.2 displayed a statistically significant productivity gap between titled and untitled farms. Leaving aside for now the question of whether the gap reflects a security-induced demand effect or a credit-supply effect, a more fundamental question is whether the gap reflects an effect of title at all, or whether it simply reflects the impact of other characteristics of the farms which have title.

Figure 3 displays a hypothetical population relationship (or population regression function) between a farm's "market access" and the present value of an investment project to that farm. The term market access is used here in a shorthand way to indicate the terms on which a farm unit can gain access to capital and participate in other commercial relationships. As section 3 below demonstrates empirically, market access has a major effect on agricultural choice of technique and productivity in Kenya. In the notation of equation (1), the flow of returns to an investment project are nondecreasing in M ($d\pi/dM \geq 0$) and the shadow price of capital is nonincreasing in M ($dr/dM \leq 0$). The present value of an irrigation investment, for example, is higher for a farmer who can obtain the capital needed to buy additional seeds and fertilizer and who can sell the additional produce generated at favorable prices, than it is for a farmer who is less favorably placed.

To keep matters simple, the current cost of the investment, C^*, is assumed to be independent of market access. In conformity with the model represented by equations (1)-(3), any farm for which E[PV] exceeds C^* will undertake the investment project. M^* represents the level of market access at which investment on a titled field would become worthwhile. The lower of the two curves in figure 3, no title, represents the expected present value of the investment for farms lacking title to the field on which the investment would be made. A change in titled status for a particular field generates a given

Figure 3: Investment and Market Access



change in $\phi_k(T_k)$ regardless of market access; thus EPV shifts proportionally upward for titled fields to the title curve. The proportional shift in the E[PV] function for titled plots asymmetrically favors farms with better market access under a variety of reasonable conditions.[3]

As noted, figure 3 represents a hypothetical population relationship. True population relationships are of course not observed--data are necessary to estimate them. A question which confronts the effort to identify true title effects is whether existing titled and untitled farms are randomly distributed over market access, M. If title acquisition and maintenance are costly, however, such random distribution is unlikely, since only farmers who anticipate sizable gains from titling will seek to acquire titles. Then the separation of farms into titled and untitled groups is likely to be systematically related to factors such as market access.[4]

To illustrate the importance of nonrandom, systematic sample separation, figure 4 reproduces figure 3 with the addition of hypothetical data points on titled and untitled farms (shown as "+'s" and "o's," respectively) scattered around the respective population regression functions. By assumption, the observed titled farm units have better market access than the untitled farms. Mean expected investment returns for the observed titled farms is $E[\overline{PV}_T]$, well above the mean for the group observed without title, $E[\overline{PV}_N]$. The gap between these two levels is analogous to productivity gaps in yields and net returns which were found empirically in section 2.2.

What does the gap defined by the vertical distance $E[\overline{PV}_T] - E[\overline{PV}_N]$ mean? It certainly does <u>not</u> measure the gains in expected present value of investment which untitled farms would experience if they were granted land title. The average impact which titling those farms would have is given by the vertical distance labeled "A." Nor does the gap identify the gains that currently titled farms experienced when they received land titles. The vertical distance labeled "B" measures that gain. The gap does estimate without bias the difference between existing titled and untitled farms. But the size of the gap reflects differences <u>both</u> in title status <u>and</u> in market access; it does not separately identify the two influences. In short, the naive statistical approach does not identify the effect of land titling when there is nonrandom separation of farms into titled and untitled groups.

Figure 5 extends the example developed in figure 3 to consider the population relation between net farm income and market access. As figure 3 is drawn, land titling would induce no investment for farms with market access below M^*, as the expected present value of returns even with title remains below investment cost C^*. For these farms, net farm income would be unaffected by land titling. For farms with market access in excess of M^*, net farm income would increase as the investment project is then undertaken profitably.

Figure 5 thus suggests a simple reason why possession of land titles is likely to be systematically related to market access, leading to the sort of nonrandom sample separation shown in figure 4:

> **Returns to land title are likely to be higher for farms better situated in terms of market access or other productivity-enhancing characteristics.**

If title acquisition and title maintenance require real expenditures, then the better-situated farms are more likely to anticipate gains from titling sufficient to justify such expenditures. They are consequently more likely to make (or to have already made) the necessary titling expenditures and thus to appear in any data set as titled farms.

Figure 4: Endogeneity of Title Status

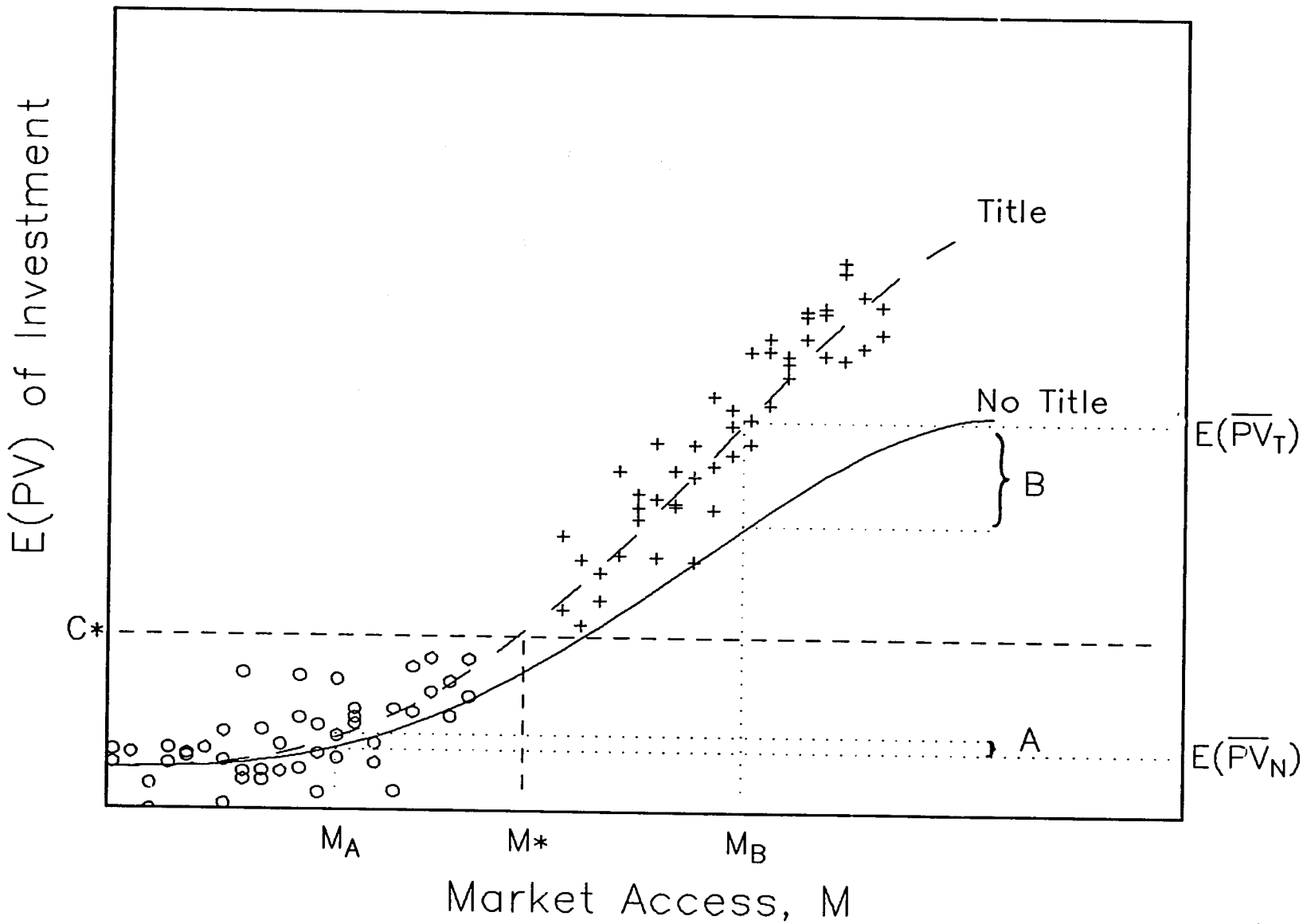
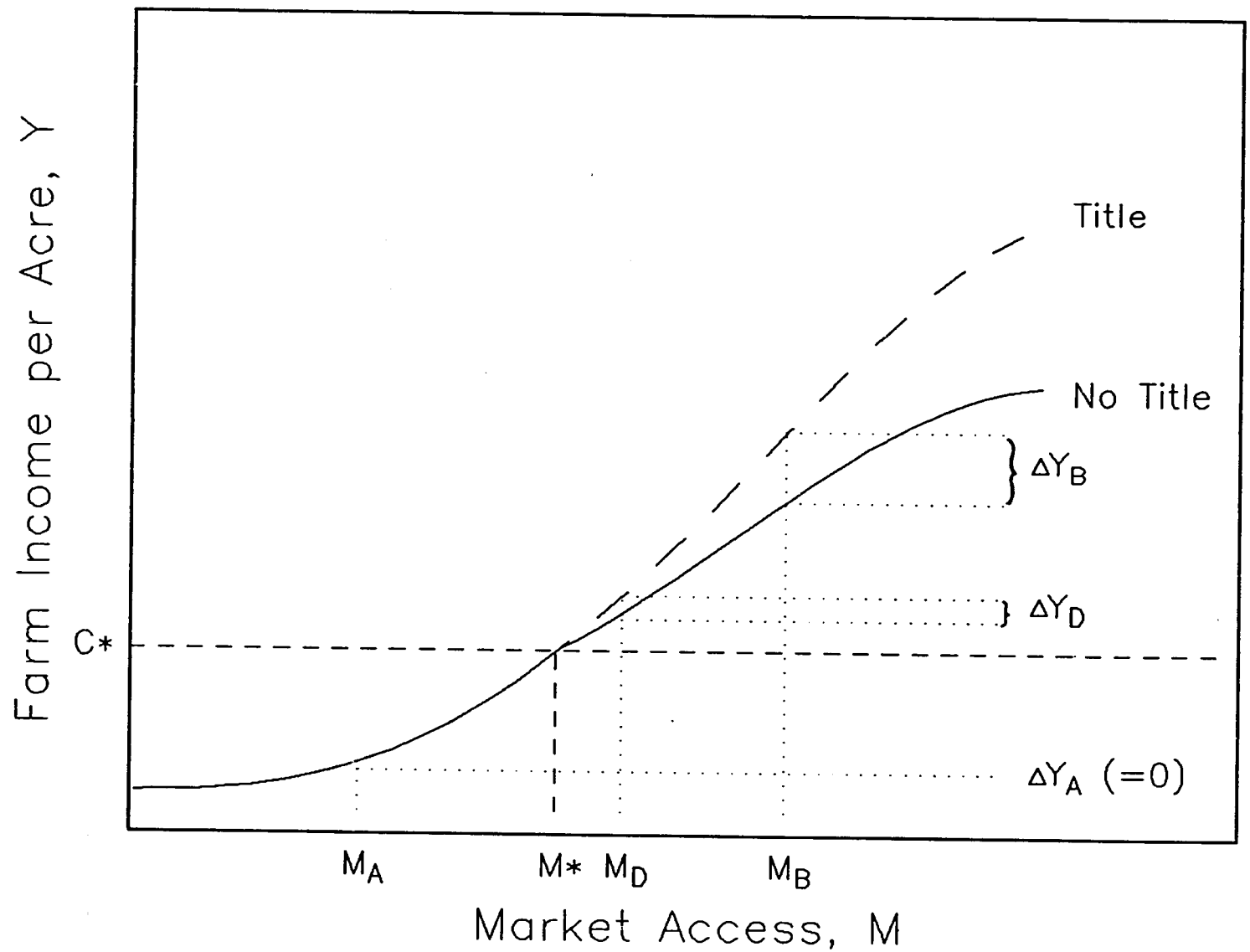


Figure 5: Farm Income and Market Access



Given these microeconomic foundations of the impact of land title, a statistical analysis which simply compares the values of outcome variables between groups of titled and untitled farms will yield incorrect results. More complex analysis, which tries to control statistically for mediating factors such as market access, is required. The ease with which that task can be done depends critically upon whether the relevant farm characteristics are measured and measurable. It may be relatively simple to control for market access: prices, wages, and interest rates can be readily observed. On the other hand, farming skill and land quality--which, like market access, would enhance the returns to land titling--are much harder to measure and to control for.[5] In any event, the likely importance of mediating factors raises the need to consider carefully the statistical identification problem.

Those same factors also raise the question, "For what kind of farmer do we wish to measure title's impact?" Suppose that all statistical identification problems were resolved and that the population relations displayed in figure 5 were unambiguously known. What then is the desired measure of the impact of title acquisition? The gap labeled "ΔY_B" measures the impact title has on income of farms which are relatively well endowed in terms of market access--for which $M = M_B$. The gap "ΔY_A" measures the impact (= 0) on farms with market access less than M^*. Farms selected at random from the entire population would, on average, experience a gain of size "ΔY_D."

These alternative measures of the gains from title have implications for program design. Should a program try to title all farms even when average gains will be small? Should a self-selection process be permitted to occur such that only the large gainers seek out title acquisition and are perhaps charged fairly high fees to cover program costs?

Differentiation in the benefits to titling thus has important consequences for the impacts of tenure reform policy. For less advantaged farmers, with size and wealth levels which leave them unfavorably situated with regard to market access, land title may be fairly meaningless. Its potential effects are overwhelmed by market access problems, leaving little incentive for title acquisition. Stronger incentives tempt the economically better-positioned farmer. A title raises the value not only of his or her initial land endowment but also the value to him or her of the land of less advantaged neighbors. To the extent that land titling programs also facilitate transactions in land, freeing up the mechanism of potential land transfer, they may thus have the unintended consequence of boosting the <u>relative</u> land acquisition incentives and economic power of the already well-endowed. It is this possibility which seems to underlie the criticism of land titling programs summarized in section 1.

2.4 Identification Problem 2: Demand versus Supply Effects of Title

In section 2.3 it was demonstrated that market access and other factors may obscure the impact of title on productivity apparent in section 2.2. A second question to ask of the results presented in section 2.2 is whether the measured maize productivity gap of 210 kilograms per acre between titled and untitled farms, for example, identifies demand effects of land title or supply effects. In terms of the model introduced earlier, a shift in tenure status of field k, T_k, affects the eviction probability of field k, and thus the expected value of investment on that particular field. The inverse relationship between eviction probability and expected returns to investment reflects a "security-induced demand effect" of title by making the farmer more confident of realizing returns to investment on a particular field.

A shift in T_k also influences the aggregate tenure status $\tilde{T}$ of the farm, as equation (2) shows. As seen in the denominator of the expected present

value equation (1), the resulting shift in $\bar{T}$ may affect the discount rate (or shadow price of capital) r, and thereby influence investment behavior and observed productivity. Changes in investment and productivity which occur through changes in the shadow price of capital will be called the "credit supply effects" of land title.

Conceptually, the discount rate in equation (1) represents the economic scarcity or shadow value of capital to the farm. For farmers who are quantity constrained in the capital market (that is, who cannot borrow as much as they would like at the observed interest rate), the shadow price of capital will generally exceed the market interest rate.[6] A legally recognized, mortgagable land title is likely to enhance the farm's collateral value as perceived by the financial system. Consistent with many studies of agricultural credit (for example, Carter 1988), the increase in collateral value may reduce the interest rate at which the farm can borrow and, more importantly, is likely to increase the amount the farm can borrow (perhaps from zero to a positive value). Either change in the conditions of credit supply will reduce the farmer's shadow price of capital, r. E[PV] would increase for all projects, and incrementally more projects would be economically worthwhile and hence undertaken; observable agricultural productivity would thus increase.

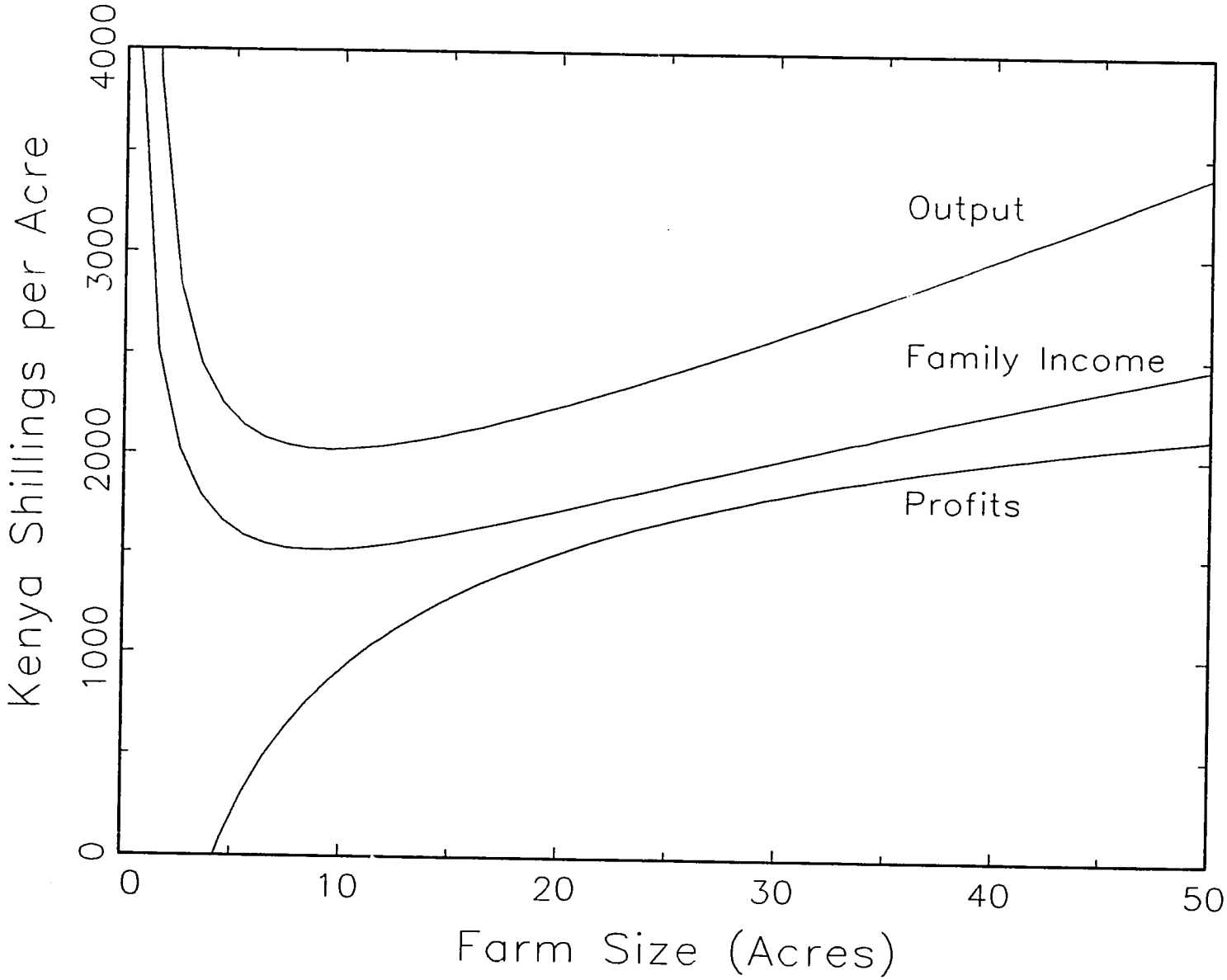
Disentangling credit supply from security-induced demand effects of land title is important because the two effects have distinct welfare and policy implications. The importance of the supply effects of land-title provision is underscored by the work of Feder et al. (1988) on Thailand. They conclude that credit supply effects are the "main source of greater productivity of lands owned legally" (p. 142). Supply effects indicate that collateral constraints, rather than tenure insecurity per se, inhibit agricultural production. In this situation, addressing the collateral problem directly (perhaps through the formation of mutual-responsibility borrowing groups) may be the most effective policy, particularly if land titling programs are expensive or involve some of the other tradeoffs mentioned earlier. In addition, as Roth et al. (1989) note in a commentary on Feder and Onchan's (1987) Thailand work, aggregate social returns to land titling may be minimal if the banking system has a fixed supply of loanable funds.[7]

In sum, appropriate policy formation requires the distinction of supply effects from security-induced demand effects. While the latter may justify land tenure intervention, the former offer a much weaker case for policy action of any sort. Such a distinction is pursued further in section 4.2.

3. Factors which Mediate the Economic Impacts of Tenure Security Programs: Multiple Market Failures in Land, Labor, and Capital

Tenure security considerations aside, farmers within the Njoro study area display highly diverse, differentiated patterns of behavior. An indication of this diversity can be seen in figure 6, which displays fitted farm productivity-farm size regression functions. (Appendix B presents the actual regression results.) The U-shaped output regression curve relates the total value of output per farm acre (at standardized prices) to the size of the farm. The family income curve relates to farm size the per-acre value of output less the value of all inputs other than family labor, while the profit curve further subtracts the imputed value of family labor. Beneath these economically and statistically significant farm size-related patterns lie two sorts of differentiated behavior: differentiation in choice of activity and differentiation in choice of technique.

Figure 6: Output and Net Returns Per Acre



The primary uses for land and other farm resources within the Njoro study area are in maize-bean intercropped fields, pastures to support dairy activities, and wheat fields. Figure 7 graphs the fitted regression functions which show the relation between farm size and choice of activity. All farms seem to put their first 4 or 5 acres into maize-bean production. Marginal acreage beyond that is allocated to pasture and fodder crops. Beyond about 15 acres, additional land is allocated to wheat cultivation. Of these activities, wheat cultivation is by far the most profitable (when inputs and outputs are valued at market prices), as Blarel et al. (1989) show in detail.

This shift to increasingly more profitable activities as farm size grows underlies in part the productivity-size relations in figure 6. In addition, choice of technique for given activities changes radically as farm size increases. The smallest farms use massive doses of family labor per acre in relatively unremunerative food crops, keeping up output per acre but creating the large negative imputed profits shown in figure 6. As farm size increases, family labor stays constant in absolute terms but is spread over a larger area. The use of purchased inputs increases only slowly so that yield, total output per acre, and family income all fall. As farm size increases further, the use of purchased inputs rises dramatically, and those inputs are increasingly applied to more remunerative activities (Blarel et al. 1989).

The existence of such sharp behavioral differentiation among producers is evidence of what Jonakin and Carter (1987) have called "multiple market failures." First, cheap family labor, in classic Chayanovian style, appears limited in its access to remunerative off-farm opportunities. While family labor is exchanged on a casual basis among small farms, there is little systematic transfer of hired labor between labor-abundant small farms and land-abundant large farms. At the same time, the failure of larger producers to transfer land to small holdings (as a way to exploit the cheap labor in residence there) indicates a second market failure that limits the economic capacity of the smaller units. Third, given that the smaller classes of farmers choose nonworking capital-intensive activities and techniques, a reasonable hypothesis is that the capital market is strongly imperfect and that access to capital is strongly stratified by farm size (Blarel et al. 1989). Finally, and related to the hypothesis of a capital market failure, the apparent subsistence-first strategies of small and large holders may be related to imperfect risk and insurance markets (see, for example, Wiebe 1991).

If this multiple-market-failures explanation of farm size-differentiated behavior is correct, then the shadow prices of capital and labor ought to be strongly related to farm size, with the shadow price of labor positively related to farm size and the shadow price of capital inversely related to farm size. Shadow prices are themselves not observable. Marginal factor productivities can, however, be taken as reasonable representations.[8] After using data on maize-bean cultivation to estimate a Cobb-Douglas representation of the production technology, marginal products of capital and labor were estimated for each farm in the Njoro sample. These estimates were then regressed on farm size, yielding the fitted regression functions graphed in figure 8 and confirming expectations about capital and labor market failures. Specifically, divergence between estimated shadow prices and market prices suggests that small farms are constrained in their access to capital while larger farms appear constrained in their access to labor.

Market access is thus an important factor in Njoro's agricultural decision-making environment and appears strongly related to farm size. As the discussion in section 2 argued, market access may condition or mediate the impact of land title on individual production and investment incentives. In addition, in environments where land title is not randomly allocated (and

Figure 7: Area by Crop Activity

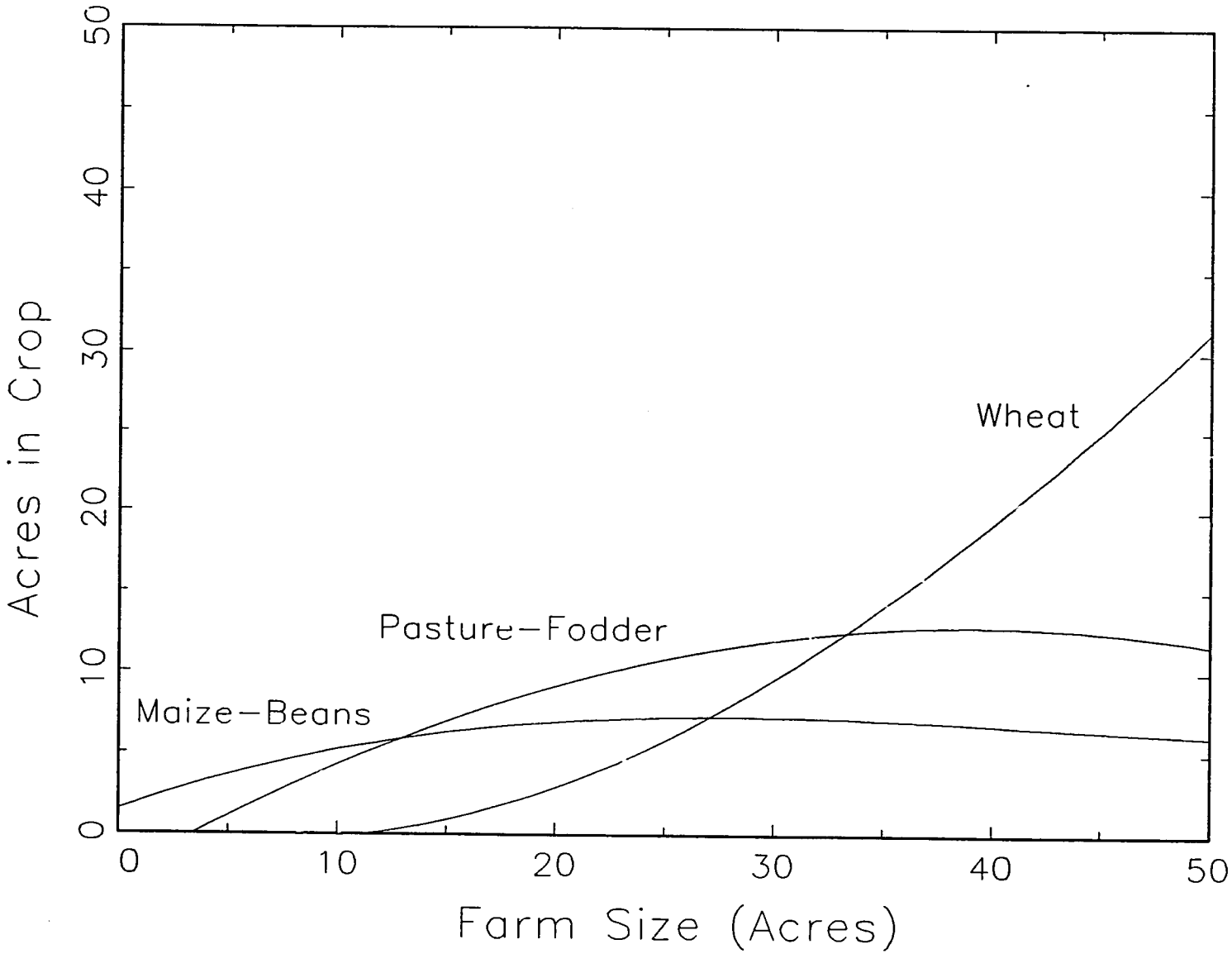
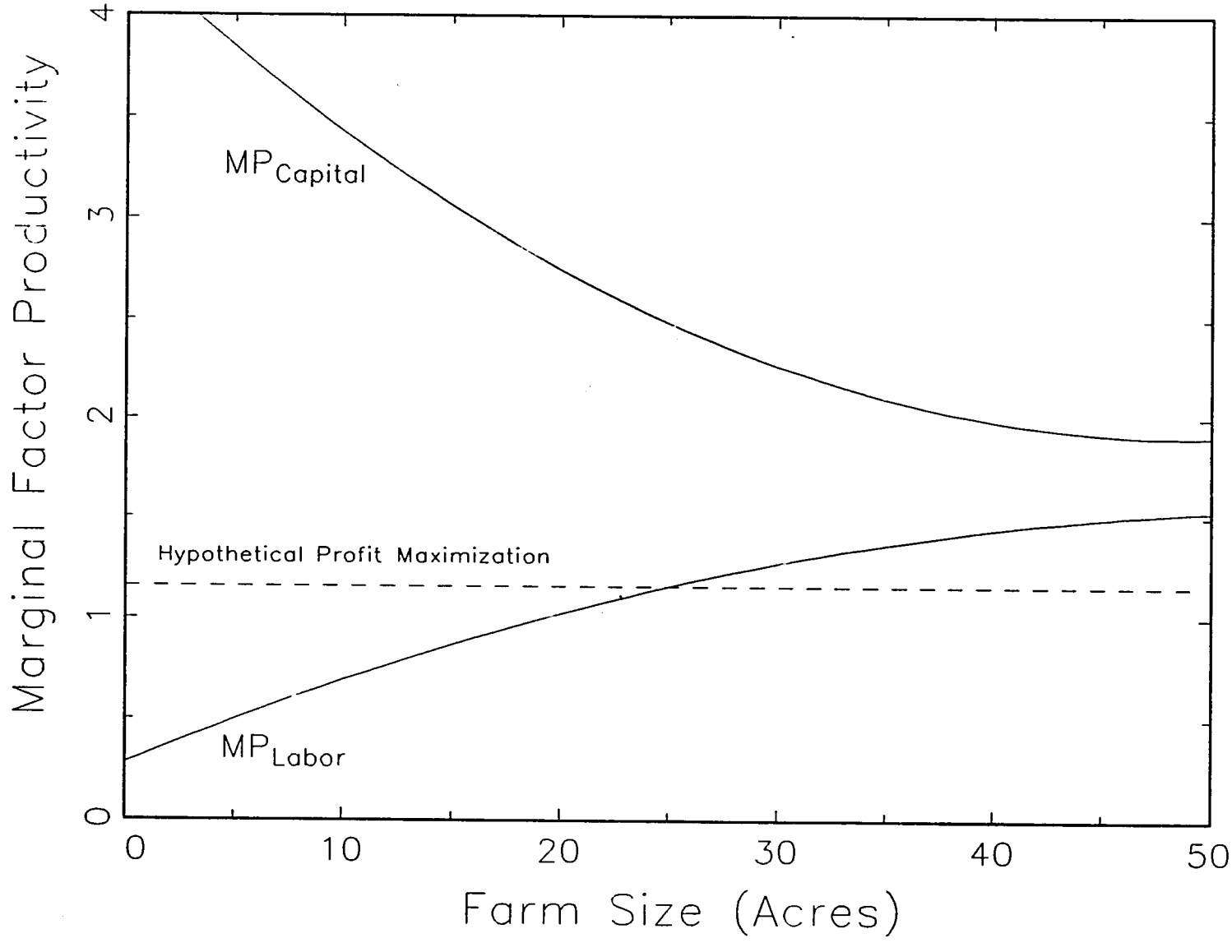


Figure 8: Factor Productivity by Farm Size



costlessly maintained), market access may also influence which farms are actually observed to possess title. In the Njoro study area, severe capital constraints, which seem to limit expansion of small farms into more remunerative activities, may completely overwhelm any potential benefits to title for small-scale producers (except to the extent that title acquisition itself has a major impact on access to capital). Within this imperfect market environment, the impact or potential impact of land title is likely to be differentiated across producers, something which empirical and policy analysis must take into consideration.

4. Identification of the Differentiated Impact of Land Title within Imperfect Market Environments

Titled farms in the Njoro sample differ on average from untitled farms, as the statistics in section 2.1 showed. But, as the intervening sections have argued, it is inappropriate simply to identify title as the cause of these "naively" estimated differences between titled and untitled farms. Within the imperfect market environment which characterizes rural Kenya, other factors that may well be correlated with title status, particularly market access, are expected to have a major impact on farm resource allocation and productivity. In addition, careful consideration suggests that the impact of land titles may well be different for farmers who enjoy different degrees of market access. The question of land title's impact must be modified in order to determine what kind of farmer it is that is the subject of such impact.

Section 4.1 tries to resolve the underlying identification problem and estimate what (if any) part of the observed differences between titled and untitled farmers can be identified as a true effect of title, and what part is simply a spurious correlation between title and other mediating factors. The statistical model will be specified to test for the possibility of size-differentiated land title effects. Finally, section 4.2 implements a methodology to distinguish what section 2.4 called the credit-supply effects of title from the security-induced demand effects.

4.1 Identifying True Effects of Title on Productivity in Njoro

In figure 6, three measures of farm productivity were seen to vary significantly with farm size. Do these size-productivity relationships hold when the effects of title are incorporated simultaneously? We now consider formally the relationship between productivity and title net of the effects of farm size, which, along with mode of access, has been introduced as a proxy for farmers' access to resources and markets. This is accomplished by extending the regression analysis underlying figure 6 to include dummy variables for title and for that particular mode of access--the land-buying company--which is expected to be most strongly associated with active market participation. (Various measures that may reflect market access in Njoro, such as the use of commercial inputs, formal credit, and remittances, sharply distinguish farms on the basis of land-buying company participation as well as of farm size. This may be understood when one considers that while participants in land-buying companies had the resources to acquire land competitively, beneficiaries of settlement schemes are more likely to have been targeted on the basis of need.) In addition, the potential effect of title is allowed to vary with farmers' degree of market access. Three dependent variables--output, family income, and profits--are evaluated in turn. This specification will indicate whether potential gains from land-titling efforts are universally distributed or limited to particular groups of farmers.

Weak coefficients on title variables (see appendix B) indicate that the significant differences between titled and untitled farms observed earlier in table 2 are due not to true title effects but to the spurious correlation between title status and other important mediating factors. In general, coefficients on size and land-buying company participation dominate title in magnitude and in statistical significance for all three productivity measures. It thus appears that farm size and mode of access, as measures of producers' market access, are powerful enough to overwhelm title effects between farms in the sample.

Correlated productivity relations are presented in figure 9. The "U" shape of output and family income and the monotonically increasing form of profits revealed in figure 6 are reaffirmed in the current expanded specifications, indicating the importance of the relationship between farm size and productivity in general. Figure 9 also illustrates the special productivity features which characterize farms originating from the subdivision of land-buying companies. Both output and family income are significantly higher on small LBC farms and lower on larger LBC farms than they are on non-LBC farms. This suggests that the higher levels of nonfarm income and market access which may have enabled some farmers to participate in land-buying companies in the first place are particularly beneficial to the sample's smaller farms. Profits do not differ significantly by mode of access.

While title effects tend to be overwhelmed by the effects of differences in size and mode of access between sampled farms, it remains possible to investigate the potential role of title within individual farms, where the two proxies for market access are held constant but the title status of particular fields may vary. This possibility is pursued in the next section in an analysis of the second identification problem, raised in section 2.4: distinguishing security-induced demand effects from credit-supply effects.

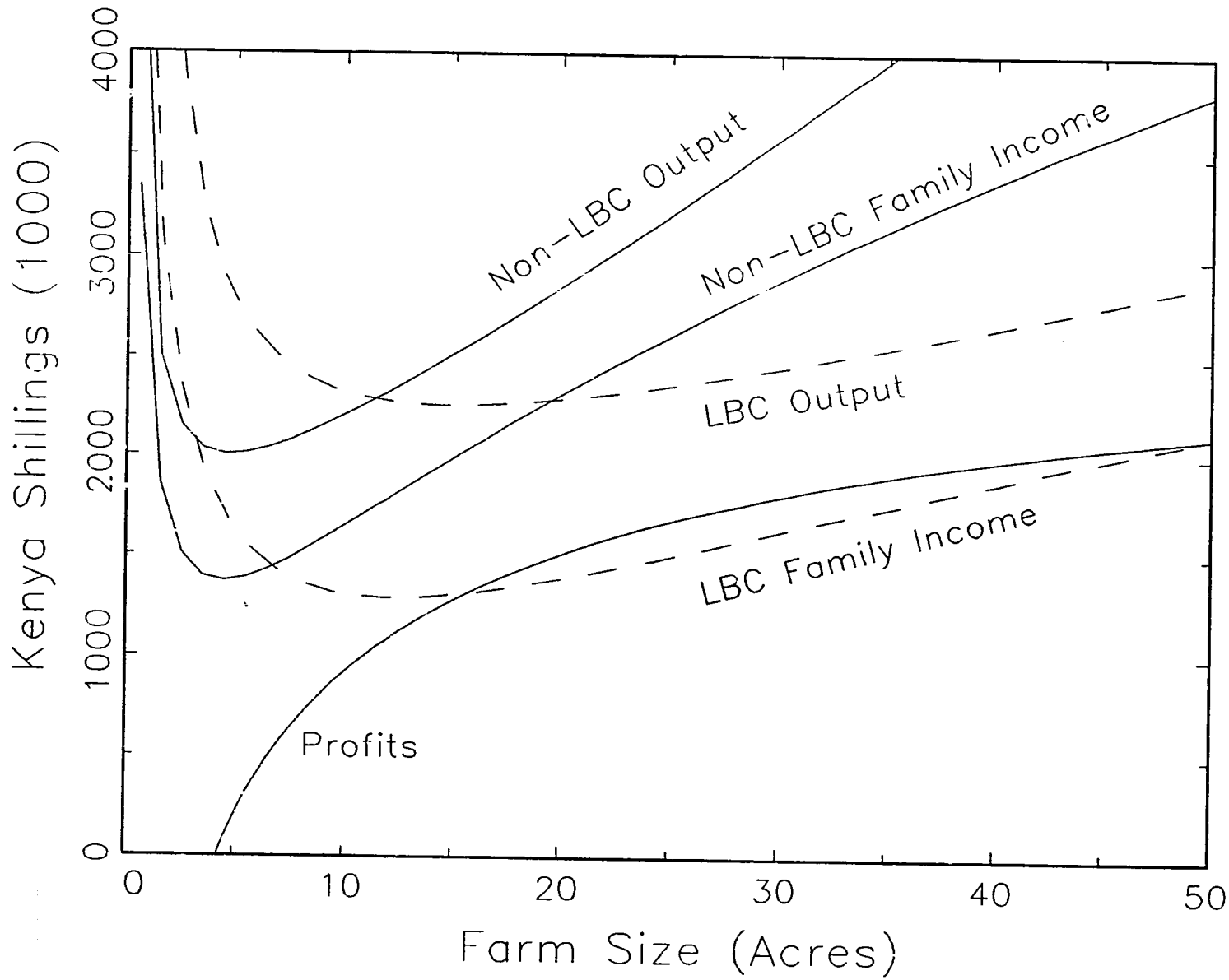
4.2 Identification of Demand versus Supply Effects of Title in Njoro

While both the security-induced demand effects of land title and the credit-supply effects imply greater agricultural investment and productivity, there is one key difference in their implications which can be used to identify separately the magnitude of the two effects.

Suppose a farmer receives legal title to field k. In the notation of section 2.1 above, the receipt of title implies a change in the value of T_k and a lesser change in $\bar{T}$. Following this change, security-induced demand effects will increase investment and productivity only on the newly titled field k because it is only on that particular field that the farmer's likelihood of realizing returns to investment has increased. Credit-supply effects will also occur with the increase in $\bar{T}$. In contrast to demand effects, however, supply effects will symmetrically increase investment incentives on all the farm's fields. This is because credit-supply effects decrease the shadow price of capital, as noted in section 2.4 above, and hence increase the profitability of any given investment on the farm.

To the extent that security-induced demand effects are operative, investment and productivity should be disproportionately high on a given farmer's titled fields as opposed to fields held without title. Confirmation of demand effects would support our maintained hypothesis that reduced legal exposure to eviction actually implies reduced insecurity of tenure. If only credit-supply effects occur, then for any particular farm there should be no difference between investment and productivity on titled and untitled fields. In this latter scenario, investment and productivity on farms which are least partially titled could be higher than on farms which on average have a lesser degree of titling (that is, farms for which $\bar{T}$ is less).

Figure 9: Output and Net Returns Per Acre



It is thus possible to disentangle potential supply and demand effects of title if there are producers whose farms are composed of fields held under different tenure arrangements. Of 109 farms surveyed in Njoro, 26 cultivated multiple maize and beans fields under more than one tenure arrangement. For the subsample of 26 farms with fields under multiple tenure arrangements, field-level data were transformed as follows:

$$x^{*}_{ik} = x_{ik} - \bar{x}_{i}, \qquad (4)$$

where x_{ik} 's the untransformed observation for field k on farm i, and $\bar{x}_i = \Sigma_k x_{ik}/n_i$ is the mean across all n_i of farm i's fields. For example, if x_{ik} measures maize yield from field k of farm i, then a positive value of the transformed variable x^{*}_{ik} would indicate that yields on field k are higher than the average of farm i's other fields. If security-induced demand effects are systematically operative, then field-level indicators of economic performance transformed according to equation (4) ought to be positive on average for titled fields. If only credit-supply effects are operative (or if title has no economic impact), then the value of such transformed indicators should bear no relation to field-specific tenure status and the average of transformed variables would be zero for titled fields.

Principal maize-beans inputs and outputs are presented in deviation form in table 3. On average, nonlabor inputs are applied less intensively on titled fields than they are on the untitled or other fields of the same farm. (Maize seeds, for example, are applied at a rate of 0.77 kilograms per acre less on titled fields than they are on farms considered as a whole. Rented fields receive 2.11 kilograms per acre more than do titled fields, or 1.34 kilograms per acre more than does the farm overall.) Chemicals, however, are applied more intensively on titled fields than they are on untitled or other fields.

The picture for labor is mixed. Male labor is applied more intensively on untitled fields than on titled fields. Female labor, on the other hand, is applied most intensively on titled fields. This holds true for regular hired labor as well, though more casual labor is hired to work on untitled and rented fields than on titled fields.

Results for outputs are mixed as well. Maize yields are more than 400 kilograms per acre higher on rented fields than they are on both titled and untitled fields of the same management unit. Potato yields, by contrast, are highest on untitled fields, while bean yields are greatest on titled fields.

Data disaggregated by particular inputs and outputs thus provide no confirmation of the existence of security-induced demand effects of title. Are such effects visible in more aggregated measures? Title's effects on the aggregate value of inputs and outputs were tested using ordinary least squares regression analysis incorporating dummy variables for ownership with title, ownership without title, rental arrangements, and borrowing. Coefficients indicate the average deviation from farm "i's" mean value of inputs or outputs (per acre of maize and beans cultivated) on fields which are held under the various tenure arrangements. The existence of security-induced demand effects should be revealed in input and output levels which are highest on those fields which are held under the most secure tenure arrangements. If registered title does indeed offer such security, we would expect to find significant productivity gains demonstrated on titled fields.

Actual regression results are presented in appendix B. Estimated coefficients are not significantly different from one another or from zero, indicating that tenure security-induced demand effects, if operative at all, are overwhelmed by other factors which influence farmer decision-making with

Table 3. Deviations from Farm-Mean Quantities of Inputs and Outputs in Maize-Beans Cultivation by Field Tenure Status (per acre of maize-beans cultivated)

	Title	No Title	Rented	Given
Number of fields	19	16	33	4
Field size (acres)	3.38	1.64	1.56	1.10
Inputs				
NonLabor				
Maize seeds (kg)	-0.77	0.10	1.34	-5.09
Bean seeds (kg)	0.64	-2.62	0.94	-4.60
Potato seeds (kg)	-4.33	2.08	4.26	0.98
Manure (kg)	-49.09	164.19	-14.85	-87.62
Fertilizer (kg)	-3.00	-4.32	6.92	-11.41
Chemicals (KSh)	4.18	-12.67	2.30	-12.67
Family Labor (hr*)				
Male	-1.84	6.89	-4.12	34.18
Female	20.42	-0.13	-18.72	-78.14
Child	-2.06	19.07	-7.66	6.29
Hired Labor (hr)				
Casual	-43.62	38.86	42.82	-96.34
Regular	9.36	-10.02	-5.35	-14.46
Machine Services (KSh)	3.33	-59.04	32.36	-75.91
Outputs (kg)				
Maize	-121.87	-168.51	279.29	-488.12
Beans	14.88	-17.57	-6.22	-39.58
Potatoes	-69.59	138.44	21.10	-55.83

* In adult equivalent units: male = 1.00; female = 1.00; child = 0.50.

respect to production. (Rented fields may, for example, differ in quality from owned fields and may be sought especially for characteristics favorable to commercially oriented production.) This failure to find any significant evidence of security-induced demand effects of land title parallels the similar failure of Feder et al. (1988) in their study of Thailand and indicates that provision of legal title has little impact on farmers' perceptions of the security with which they hold land.

5. Summary and Conclusions

The standard argument for tenure reform centers on the role of uncertainty in discouraging investment on land which is held without long-term security. Land title which enhances such security may induce investment and productivity increases both from the demand side, as farmers become more certain of reaping investment's benefits in the future, and from the supply side, by affording farmers better access to credit.

In a world where access to markets is imperfect, both demand and supply effects may be limited to those farmers who are already well endowed with agricultural resources and access to markets. As a result, tenure reform policies may have very different effects on different classes of farmers. An important question is raised: "For whom does enhanced tenure security bring productivity gains?"

In addition, when title acquisition is costly, identification and measurement of the impact of tenure reform is complicated because the best-endowed farmers, most likely to benefit from enhanced tenure security, are also most likely to seek title to their land. Farmers less favorably endowed are in turn less likely to acquire title. Simple comparison of the performance of observed titled and untitled farms thus tends to overstate both the realized impact of title on farmers who have obtained it and the potential impact of title on those who have not.

This paper began with a "naive" presentation of the apparent effects of registered land titles on agricultural productivity in Njoro, Kenya. Subsequent theoretical and empirical development sought to disentangle true title effects--whether induced by investment demand or by credit-supply considerations--from those of other mediating factors. It was demonstrated that titles' effects are indeed overwhelmed in Njoro by factors such as farm size and mode of access to land. In particular, multiple failures in land, labor, capital, and insurance markets contribute to the persistence of pronounced size-related patterns of technique and activity choice among smallholders. Within this imperfect environment, the impact of land title is differentiated across producers, and market access conditions the impact of land title on farmers' production and investment incentives.

Efforts to enhance smallholder productivity via land tenure reform alone are thus likely to meet with limited success: title status appears to be less important in the determination of farm productivity than are other factors such as market access. Furthermore, in light of the link between these other factors and farmers' existing endowments of land and other resources, tenure reform's distributional effects may prove as worthy of future attention as are its potential consequences in terms of efficiency.

Appendix A. The Njoro Data Set

The data used in this paper were collected as part of a more general effort to study socioeconomic constraints to agricultural productivity in the Njoro small-farm sector [see Blarel et al. (1989) for more details]. This study defined its population as those small holdings of land which originated from the subdivision of large settlers' farms or from Settlement Fund Trustee (SFT) schemes. A census of ex-large farms and SFT schemes identified 103 such units, 39 of which have actually been subdivided into smallholdings. For some of the 39, subdivision maps were not available; these were removed from the sample frame. The final sampling frame consisted of 24 ex-large farm/SFT units, which have been subdivided into 6,658 individual smallholdings covering a total area of 46,882 acres.

Cost and logistical considerations dictated a sample size of 125 smallholdings; casualties of various sorts reduced this number to 109 units for the analysis. To avoid a wide geographical dispersion of sampled units, which would have strained project interview resources, a three-stage sampling procedure was devised:

> Stage 1: Five ex-large farms or settlement schemes were randomly selected with probabilities equal to each unit's area as a proportion of the total area in the sampling frame.
>
> Stage 2: Five clusters of parcels were randomly selected from the subdivision list of each unit selected in stage 1.
>
> Stage 3: Five parcels were randomly selected from each cluster selected in stage 2.

In practice, the above procedure was modified to permit an overrepresentation of the stratum of parcels greater than 15 acres in size. Prior to stage 1, the list of 24 subdivided ex-large farm/SFT units was stratified into three groups as separate subpopulations on the basis of parcel size. Two ex-large farm/SFT units were selected from each of the first two groups (containing smaller parcels), and one unit from the last group (containing larger parcels). This stratification ensured adequate representation of the larger parcels for later statistical and econometric analysis.

Two ex-large farms/SFT units were selected from group 1 (parcel size less than 5 acres) because that group was underrepresented in the sampling frame due to constraints on sampling methodology. This stratification and sampling procedure generated the following sample:

> 50 parcels smaller than 5 acres,
>
> 50 parcels between 5 and 15 acres in size, and
>
> 25 parcels larger than 15 acres.

The sample selection procedure yielded a set of parcels or plot units (PUs) as defined by the recorded subdivision of ex-large farms/SFT units into freehold parcels. The PU is not, however, the final unit of observation. In some cases, part or all of a PU was rented out or even sold. In other cases fields were rented in, purchased or borrowed, and brought under an integrated management strategy along with a household's PU. For purposes of survey consistency, it was necessary to establish the integrated farm management unit

(or IMU, which may or may not be co-extensive with the PU) as our unit of observation. In the text, IMUs are referred to simply as farms. The IMU is defined as the set of fields organized as an economically interdependent unit by a single operator. Nonlocal agricultural land (defined as that outside Njoro Division) is treated as a source of external non-IMU income (as are a son's remittances from Nairobi, for example).

For each IMU so defined, an inventory of all cultivated fields was conducted. Except for information on the socioeconomic characteristics of the household, all data (for example, on inputs and outputs) were collected on a field-by-field basis through biweekly interviews over the 1985/86 cropping year. Data on the final sample of 109 IMUs are constructed from information collected from the nearly 700 separate fields cultivated by these units.

Appendix B. Regression Results

Figure 6. Size-Productivity Regressions

Ln(**Output** per acre) on Constant, lnSIZE, and $lnSIZE^2$

--VARIABLE------	COEFF----	STD ERR-----	T-STAT-------	P-VALUE-------
Constant	8.576	0.193	44.495	0.000
lnSIZE	-0.856	0.196	-4.376	0.000
$lnSIZE^2$	0.190	0.046	4.097	0.000

Observations:	109.000	Degrees of freedom:	106.000
Residual SS :	24.074	Total SS :	28.455
R-squared :	0.154	Rbar-squared :	0.138
Regr F-stat :	9.643	P-value of F :	9.437E-006
Std error :	0.477		

Family Income per acre on Constant, lnSIZE, and $lnSIZE^2$

--VARIABLE------	COEFF----	STD ERR-----	T-STAT-------	P-VALUE-------
Constant	3016.265	459.724	6.561	0.000
lnSIZE	-1376.827	466.358	-2.952	0.004
$lnSIZE^2$	315.466	110.581	2.853	0.005

Observations:	109.000	Degrees of freedom:	106.000
Residual SS :	1.370E+008	Total SS :	1.482E+008
R-squared :	0.076	Rbar-squared :	0.059
Regr F-stat :	4.360	P-value of F :	0.006
Std error :	1136.759		

Profits per acre on Constant, lnSIZE, and $lnSIZE^2$

--VARIABLE------	COEFF----	STD ERR-----	T-STAT-------	P-VALUE-------
Constant	-1928.707	444.528	-4.339	0.000
lnSIZE	1524.031	450.943	3.380	0.001
$lnSIZE^2$	-125.765	106.926	-1.186	0.238

Observations:	109.000	Degrees of freedom:	106.000
Residual SS :	1.281E+008	Total SS :	2.070E+008
R-squared :	0.381	Rbar-squared :	0.370
Regr F-stat :	32.644	P-value of F :	0.000
Std error :	1099.185		

Figure 9. Extended Size-Productivity Regressions

Ln(**Output** per acre) on Constant, lnSIZE, $lnSIZE^2$, Title, Title*lnSIZE, LBC, and LBC*lnSIZE

--VARIABLE------	COEFF----	STD ERR-----	T-STAT-------	P-VALUE-------
Constant	8.014	0.234	34.217	0.000
lnSIZE	-0.531	0.219	-2.424	0.017
$lnSIZE^2$	0.171	0.078	2.194	0.030
Title	-0.083	0.448	-0.185	0.854
T*lnSIZE	0.032	0.251	0.129	0.897
LBC	0.961	0.259	3.708	0.000
LBC*lnSIZE	-0.395	0.143	-2.761	0.007

Observations:	109.000	Degrees of freedom:	102.000
Residual SS :	20.516	Total SS :	28.455
R-squared :	0.279	Rbar-squared :	0.237
Regr F-stat :	6.578	P-value of F :	1.841E-006
Std error :	0.448		

Family Income per acre on Constant, lnSIZE, $lnSIZE^2$, Title, Title*lnSIZE, LBC, and LBC*lnSIZE

--VARIABLE------	COEFF----	STD ERR-----	T-STAT-------	P-VALUE-------
Constant	2290.911	584.638	3.919	0.000
lnSIZE	-1239.767	546.686	-2.268	0.024
$lnSIZE^2$	416.371	194.459	2.141	0.034
Title	251.083	1117.337	0.225	0.823
T*lnSIZE	-3.921	626.918	-0.006	0.995
LBC	1603.682	647.476	2.477	0.015
LBC*lnSIZE	-844.670	357.090	-2.365	0.020

Observations:	109.000	Degrees of freedom:	102.000
Residual SS :	1.278E+008	Total SS :	1.482E+008
R-squared :	0.138	Rbar-squared :	0.087
Regr F-stat :	2.714	P-value of F :	0.013
Std error :	1119.500		

Profits per acre on Constant, lnSIZE, $lnSIZE^2$,
Title, Title*lnSIZE, LBC, and LBC*lnSIZE

--VARIABLE------	COEFF----	STD ERR-----	T-STAT-------	P-VALUE-------
Constant	-1470.510	571.971	-2.571	0 012
lnSIZE	1286.993	534.841	2.406	0.018
$lnSIZE^2$	-43.573	190.246	-0.229	0.819
Title	188.126	1093.128	0.172	0.864
T*lnSIZE	-283.602	613.335	-0.462	0.645
LBC	-963.019	633.447	-1.520	0.132
LBC*lnSIZE	337.489	349.353	0.966	0.336

Observations:	109.000	Degrees of freedom:	102.000
Residual SS :	1.224E+008	Total SS :	2.070E+008
R-squared :	0.409	Rbar-squared :	0.374
Regr F-stat :	11.754	P-value of F :	0.000
Std error :	1095.244		

Section 4.2 Demand versus Supply Effects of Title.

Field-Specific Deviations from Farm-Mean Levels of Inputs and Outputs (KSh/acre) on Tenure Dummy Variables.

Deviations in	Title	No Title	Rented	Given
Inputs	87.63	108.82	34.08	-289.86
	(148.94)	(162.30)	(113.01)	(324.60)
Outputs	-58.44	71.21	324.15	-496.66
	(220.90)	(240.72)	(167.61)	(481.43)

(Figures in parentheses are standard errors.)

Notes

1. In addition to tenure reform, Swynnerton recommended that African farmers be permitted increased access to cash-crop production, technical assistance, and marketing facilities--in short, a complete reversal of their former exclusion from opportunities available to European farmers.

2. This statement of course assumes that there exists a range of economically and technologically feasible projects; see Roth et al. (1989) for reservations about this assumption.

3. In particular, this is true when $d\pi/dM > 0$ and $dr/dM < 0$.

4. A true experimental design--where the population of farms was randomly divided into experiment (titled) units and control (untitled) units--would yield a situation where the simple mean difference between the two groups gives an unbiased estimate of the average effect of title.

5. "Selectivity bias" econometrics offers one response to such latent variable problems. See Boldt (1989) for an application of this method to land titling in Ecuador.

6. Carter and Kalfayan (1989) give a more detailed exposition of the shadow price of capital.

7. In their reply to this comment, Feder and Onchan (1989) dispute the relevance of this assumption.

8. The value of an input's marginal product represents the gain in output which would be generated by an additional unit of that input. As such the marginal product indicates the maximum value, or shadow price, that a producer is willing to pay for such an additional unit.

References

Barrows, Richard, and Michael Roth. 1989. "Land Tenure and Investment in African Agriculture: Theory and Evidence." Land Tenure Center Paper, no. 136. Madison: Land Tenure Center, University of Wisconsin.

Blarel, B., M. Carter, C. Onyango, and K. Wiebe. 1989. "Economic Constraints to Agricultural Productivity in Njoro Division, Kenya." Agricultural Economics Staff Paper, no. 297. Madison: Department of Agricultural Economics, University of Wisconsin.

Boldt, R. 1989. "The Effects of Land Titling on Small Farm Production in the Highlands of Ecuador." Ph.D. dissertation, University of Wisconsin-Madison.

Carter, M. 1988. "Equilibrium Credit Rationing of Small Farm Agriculture." *Journal of Development Economics* 28: 83-103.

Coldham, S. 1979. "Land-Tenure Reform in Kenya: The Limits of Law." *Journal of Modern African Studies* 17: 615-627.

Collier, P., and D. Lal. 1986. *Labour and Poverty in Kenya 1900-1980.* Oxford: Clarendon Press.

Feder, G., and T. Onchan. 1989. "Land Ownership Security and Farm Investment: Reply." *American Journal of Agricultural Economics* 71: 215-216.

_____. 1987. "Land Ownership Security and Farm Investment in Thailand." *American Journal of Agricultural Economics* 69: 311-320.

Feder, G., T. Onchan, Y. Chalamwong, and C. Hongladaron. 1988. *Land Policies and Farm Productivity in Thailand.* Baltimore: Johns Hopkins University Press.

Haugerud, A. 1983. "The Consequences of Land Reform among Smallholders in the Kenyan Highlands." *Rural Africana* 15-16: 65-89.

Jonakin, J., and M. Carter. 1987. "The Economic Case for Land Reform: An Assessment of the Farm Size/Productivity Relation and Its Impact on Policy." Unpublished paper. Madison: Land Tenure Center, University of Wisconsin.

Kenya. 1983. *Farm Management Handbook of Kenya.* Volume 11. Nairobi: Government Printer.

Kenya. Central Bureau of Statistics. 1979. *National Census Report.* Nairobi: Government Printer.

Kenya. Central Bureau of Statistics. 1977. *Agricultural Census of Large Farms.* Nairobi: Government Printer.

Leo, C. 1978. "The Failure of the 'Progressive Farmer' in Kenya's Million Acre Settlement Scheme." *Journal of Modern African Studies* 16.

Njeru, E. 1978. "Land Adjudication and its Implications for the Social Organization of the Mbere." Land Tenure Center Research Paper, no. 73. Madison: Land Tenure Center, University of Wisconsin.

Odingo, R. 1982. "The Dynamics of Land Tenure and of Agricultural Systems in Africa: Land Tenure Study in the Nakuru, Kericho, and Machakos Areas of the Kenya Highlands." Rome: Food and Agriculture Organization.

Okoth-Ogendo, H. 1982. "The Perils of Land 'Tenure' Reform." Paper presented at the Workshop on Land Policy and Agricultural Production in Eastern and Southern African Countries, held in Gaborone, Botswana.

_____. 1981. "Land Ownership and Land Distribution in Kenya's Large-Farm Areas." In *Papers on the Kenya Economy: Performance, Problems, and Policies*, edited by Tony Killis. Nairobi: Heinemann Educational Books.

Roth, M., R. Barrows, M. Carter, and D. Kanel. 1989. "Land Ownership Security and Farm Investment: Comment." *American Journal of Agricultural Economics* 71: 211-214.

Shipton, P. 1989. "Land and the Limits of Individualism: Population Growth and Tenure Reform South of the Sahara." Development Discussion Paper, no. 320. Cambridge: Harvard Institute for International Development, Harvard University.

_____. 1988. "The Kenyan Land Tenure Reform: Misunderstandings in the Public Creation of Private Property." In *Land and Social Change in Africa*, edited by R. Downs and S. Reyna, pp. 91-135. Hanover, NH: University Press of New England.

Swynnerton, R. 1954. *A Plan to Intensify the Development of African Agriculture in Kenya*. Nairobi: Government Printer.

Wiebe, K. 1991. "Household Food Security and Cautious Commercialization: Agrarian Structure as Cause and Consequence in Kenya." Ph.D. dissertation, University of Wisconsin-Madison.

World Bank. 1983. *Kenya Land Issues Paper*. Report, no. 4391-KE. Washington, DC.