Efficiency Effects of Institutional Factors: Limited-Resource Farms in Northeast Argentina

Abstract: This paper analyzes technical efficiency of limited-resource farms operating in a sub-tropical environment (Province of Misiones, Argentina). Property rights over land, the degree of market exposure and food support programmes are three institutional variables that are hypothesized to lead to departures from the production frontier. Econometric analysis indicates that market exposure and receipt of food transfers increase efficiency. No effect of land ownership is detected. We argue that slash-and-burn agricultural systems allow non-owners of land to operate as or more efficiently than landowners.

INTRODUCTION

This paper focuses on agricultural households which meet consumption requirements not only through market exchange but also directly through their own production. It examines: (a) property rights; (b) access to markets; and (c) in-kind income support programmes as determinants of technical efficiency of production. The purpose of the paper is to highlight the linkages between these ‘non-traditional’ factors and efficiency in farming situations where an important proportion of the household’s consumption requirement is met through own production.

Research on these issues is not abundant. Property rights have been analyzed by scholars interested in sharecropping (e.g., Cheung, 1969). However, most of this research addresses agriculture in densely populated areas (in particular, Asia) or in areas of modern commercial farming (e.g., the USA). In contrast, this paper addresses a production situation characterized by the abundance of land and scarcity of capital. Similarly, little research has addressed the linkages between factors such as market-orientation and food-subsidy programmes on technical efficiency. These topics are explicitly analyzed here.

ECONOMICS OF LIMITED-RESOURCE FARMERS

Limited-resource farmer decision-making has received considerable attention in the literature (e.g., Wharton, 1965; and Valdés, Scobie and Dillon, 1979). T.W. Schultz’s (1964) ‘poor but efficient’ hypothesis implies that farmers in traditional settings are efficient in their allocation process. However, in a context of rapid technical change, inefficiencies may exist as information gathering and analysis constitute a constraint for farmers who often have less-than-adequate schooling.

Small farms have been analyzed using different conceptual frameworks. Economists have modelled the farming unit as a simplified production process, in which a set of inputs is transformed into a set of outputs (see, for example, Hopper, 1965; and Massell, 1967). These studies generally neglect institutional aspects related to the internal working of
firms. Alternatively, systems scientists have emphasized the complex interactions typically found in small, tropical or sub-tropical farms. A holistic approach is advantageous, as problems faced by limited-resource farmers are rarely amenable to highly abstract models. Indeed, it has been argued that research into the economics of small-farmer agriculture should take into account:

(a) The social milieu in which farm decisions are made, including customs of sharing and bequest; (b) the institutional setting and policy environment, including land tenure, credit and taxation; (c) the economic environment of farms, including long-term market prospects for inputs and outputs and, most importantly, understanding of the opportunity costs and transaction costs faced by farmers; and (d) the attitudes and personal constraints of farmers, including their desire or otherwise for change, for leisure, for education, for safety and for different foods, and their human and other capital (Hardaker, Anderson and Dillon, 1984, p.95).

Property rights over land, access to markets and access to safety nets provided by government agencies constitute three aspects of the 'social milieu' considered here.

**Property Rights**

Land tenancy studies have documented the efficiency of share-type arrangements (see Cheung, 1969; and Otsuka and Hayami, 1988). Share tenancy arrangements are generally accompanied by a well-defined set of rights both for the landowner as well as the tenant. Thus, resource allocation efficiency is not impaired. A different situation exists when property rights are ill-defined, or though defined cannot be enforced. Bottomley (1963) focuses on the inefficiency of common property in North Africa, while De Alessi (1980) provides a comprehensive review of the economic implications of different arrangements of property rights. In general, alternative property rights change the nature of incentives faced by economic agents, and therefore affect behaviour. In 'slash-and-burn' agriculture, where squatters occupy land on a *de facto* basis, uncertainty with respect to future control may give rise to inefficiencies in resource allocation. In particular, non-existent rights may affect incentives for land improvements, and hence productivity.

**Access to Markets**

Differential access to markets may result in differences in firm performance. Markets allow not only exchange of *products* but exchange of *information* as well. Access to markets, moreover, permits specialized production and therefore may result in a closer matching between resource availabilities and input requirements of production activities. This may also contribute to increased efficiency. Access to markets may be restricted by factors such as fixed costs for marketing output, fixed costs for information gathering necessary for decision-making (e.g., Goetz, 1992) or minimum output or quality requirements by purchasing agents in the case of formal or informal vertical integration (contracts).
Income Support

Income-support programmes vary widely in their objectives, scope and design. In Africa and Asia, food crises have frequently resulted in massive food-aid programmes. In other cases, transfers have been more modest. In countries attempting to increase agricultural output, food-support programmes targeted at poor families are an important policy tool. In particular, they dampen effects of increased agricultural prices that result when export taxes are reduced. One possible policy measure is to allow for relatively high food prices (thus providing incentives for production) while at the same time implementing targeted food transfer programmes for low-income households.

Relatively little research, however, has analyzed the production efficiency aspects of income-support measures such as food stamps and direct food aid. In general, these programmes benefit urban households more than rural households, as the former are net demanders and the latter are generally net suppliers of food. If a lump-sum food subsidy is given to an agricultural household, several outcomes are possible:

- If calorie supply is a binding constraint, labour effort can increase.
- A shift may occur from food to cash crops, with possible efficiency gains due to greater specialization. Availability of a ‘safety net’ may induce less conservative decision-making, and hence greater use of ‘risk-increasing’ inputs.
- Alternatively, food transfers may only substitute for market or self-consumption production. For this to happen, however, farmer behaviour must correspond to a lexicographic utility function in which leisure dominates over income once subsistence is assured.¹

THE CASE STUDY

Most studies dealing with subsistence farming focus on low-income countries, where 50–70 percent of the labour force is typically engaged in agriculture. In contrast, this study deals with a middle-income country: Argentina. Here agriculture employs less than 12–14 percent of the labour force. Income levels, although well below those of OECD countries, are much higher than those of most African and Asian countries. Subsistence farms in Argentina are an exception rather than the rule, and are confined to the northern part of the country.

The farms studied here are located in the province of Misiones. This area constitutes a three million hectare region bordered to the east and north by Brazil, and to the west by Paraguay. Approximately 50 percent of the 35 000 farms in this region can be classified as subsistence or semi-subsistence farms (INTA Misiones, 1988). The farms are characterized by a slash-and-burn type of agriculture, with low usage of modern production inputs (herbicides, fertilizers and insecticides). Sixty percent of the farmers intercrop corn with soybeans; other intercropping systems such as corn with cotton, beans or manioc are found on approximately 30 percent of all farms. Land preparation, planting and weeding are carried out manually with the help of animal power. Crop technology varies among farms: distance between corn rows, for example, ranges from 60 to 160 cm (Scattini, 1987). Table 1 shows basic indicators of resource use and output. Even for a sample of similar farms, considerable heterogeneity exists. Total farm output (including
both home-consumed and marketed output) is nine times larger for farms of stratum V compared to farms of stratum I.

The data set permits analysis of issues related to tenancy, market access and income support. Twenty-seven percent of the farmers sampled own the land they farm; the remainder are squatters who illegally occupy land owned either privately or publicly. Most of this land must be cleared of forest cover prior to cultivation. The importance of market integration (as measured by the proportion of output sold) varies considerably among farms: from 50 percent in the smaller farms to nearly 100 percent in the larger ones.

Though not reported in Table 1, farms in the sample received different amounts of food transfers. These were part of a food-support programme instituted in the mid-1980s, which periodically provided needy families with boxes of assorted foodstuffs (the ‘PAN’ programme). Half of the households received transfers that are greater than zero but less than 20 percent of their total income. Very few households received more than 20 percent of their income from transfers.

Table 1  Organization of Seventy-Five Small Farms

<table>
<thead>
<tr>
<th>Strata</th>
<th>Units</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net income:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>'000A&lt;sup&gt;a&lt;/sup&gt;</td>
<td>≤2</td>
<td>2 – 4</td>
<td>4 – 6</td>
<td>6 – 8</td>
<td>≥8</td>
</tr>
<tr>
<td>Average value</td>
<td>A</td>
<td>1217</td>
<td>2898</td>
<td>4676</td>
<td>6857</td>
<td>10 902</td>
</tr>
<tr>
<td>Output sold</td>
<td>%</td>
<td>47</td>
<td>70</td>
<td>84</td>
<td>87</td>
<td>94</td>
</tr>
<tr>
<td>Tobacco income</td>
<td>%</td>
<td>33</td>
<td>32</td>
<td>40</td>
<td>50</td>
<td>71</td>
</tr>
<tr>
<td>Percentage of farms</td>
<td>%</td>
<td>52</td>
<td>29</td>
<td>11</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Crop area&lt;sup&gt;b&lt;/sup&gt;</td>
<td>ha</td>
<td>3.9</td>
<td>4.7</td>
<td>4.4</td>
<td>4.4</td>
<td>8.0</td>
</tr>
<tr>
<td>Total capital&lt;sup&gt;c&lt;/sup&gt;</td>
<td>A</td>
<td>1089</td>
<td>1652</td>
<td>1338</td>
<td>1877</td>
<td>5240</td>
</tr>
</tbody>
</table>

Source: The data set used for this study was obtained by the Extension Agency of INTA Misiones at Oberá. It was made available to us by Carlos Acuña.

Notes: <sup>a</sup> ‘A’ refers to ‘australes’, the Argentine currency. <sup>b</sup> ‘Crop area’ refers only to annual crops. <sup>c</sup> ‘Capital’ includes tools and production livestock. It excludes buildings, fences or production animals.

THE IMPACT OF NON-TRADITIONAL FACTORS

This paper analyzes the impact of non-traditional factors (property rights, access to markets and impact of food transfers) on production efficiency. The following model is used to represent the farm production environment (farm specific subscripts omitted):

\[
Y = f(W, L, K, D, E) + v - u
\]

(2) \[ u = g(T, MA, I) + w \]
In Equation (1), traditional factors of production (labour, land, capital, draught animals and other production expenses) are represented by inputs $W, L, K, D$ and $E$, respectively. $Y$ represents total output (both sold and consumed). Equation (2) represents the relationship between institutional variables and production efficiency. Variable $T$ represents land-ownership. It is hypothesized that lack of property rights over land leads to a reduction in efficiency (measured by the average product of inputs $W - E$). This occurs because incentives for investments tied to land are severely reduced when uncertainty exists over future control of land. Variable $MA$ represents access to markets and technology sources, and it especially represents factors that lead to differences in efficiency between farms where most output is consumed as opposed to those where it is sold. Lastly, variable $I$ captures the effect of in-kind income transfers on resource allocation and production efficiency. Symbols $v, u$ and $w$ are error terms, where $E(v) = 0$, $E(u):= 0$ and $E(w) = 0$. Error term $u$ is associated with farm-specific inefficiency.

A Cobb-Douglas type of production function is used to estimate the relationship implied by Equation (1):

$$ y = \exp^{a_0} W^{b_1} L^{b_2} K^{b_3} S^{b_4} W^{b_5} $$

The inputs considered are labour (measured in adult-equivalent months), land (hectares), capital stock (australes invested in tools and production animals), draught animals and production expenses (outlays in australes for crop inputs). Tenancy status and the farm’s production system variables act as shifters of the production surface. It is assumed that these variables have no impact on the individual elasticities of production (represented by the $b_s$) of the ‘traditional’ inputs of the production process. Equation (1) was estimated with the stochastic frontier estimation method in \textit{LIMDEP} (Greene, 1992). Estimation of Equation (2) is accomplished with a linear model:

$$ u = c_0 + c_1 T + c_2 MA + c_3 I $$

$T$ is a dummy variable with value zero for non-owners of land and 1 otherwise. Variable $MA$ is calculated as $Output Sold/(Output Sold + Output for Self-Consumption)$. It is inversely related to self-sufficiency, and presumably self-sufficiency increases as access to markets and to technologies for cash food production is restricted.\(^3\) Lastly, variable $I$ is calculated as $Value of Food Transfer/Value of Total Output$.\(^4\)

\textbf{ESTIMATION RESULTS}

Estimation results for Equations (3) and (4) are shown in Tables 2 and 3. The main emphasis of this paper is on the determinants of technical efficiency, and therefore only selected aspects of Table 2 are discussed. Production theory suggests that small firms should generally experience increasing returns to additional resources. However, the sum of the elasticities of Table 2 reveals decreasing returns to scale for these units: $\eta(t)=\frac{\partial Y(xt)}{\partial t} = 0.52$ (letting $b_2 = 0$). This suggests that in the case of labour-intensive production such as analyzed here, factors associated with technology, choice of activity and production specialization can have more impact than duplication of resources. The insignificant coefficient for land is probably characteristic of slash-and-burn, small-farmer
agriculture, where constraints may be more related to capital, labour and managerial resources than to land. These farms, moreover, operate in a sub-tropical environment, with high transportation costs and output spoilage due to humidity and temperature. Increasing marketable surplus poses considerable problems for limited-resource farmers.

Table 3 shows that landownership is not significant in determining efficiency. This is surprising given the generally positive relation between property rights and efficiency found in other studies. However, slash-and-burn agriculture in situations characterized by an elastic supply of land presents some distinct characteristics. In particular, it allows squatters to 'move on' once productivity of a given land parcel has been reduced through cultivation. In sub-tropical agriculture, this may occur after a relatively few years. In fact, landownership may increase the cost of abandoning land that has deteriorated and may therefore contribute to lower and not higher productivity.

<table>
<thead>
<tr>
<th>Table 2 Production Function</th>
<th>Coefficient</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a_0$</td>
<td>6.875</td>
<td>10.12</td>
</tr>
<tr>
<td>$b_1$ (labour)</td>
<td>0.237</td>
<td>1.36*</td>
</tr>
<tr>
<td>$b_2$ (land)</td>
<td>-0.116</td>
<td>-0.72</td>
</tr>
<tr>
<td>$b_3$ (capital)</td>
<td>0.112</td>
<td>1.31*</td>
</tr>
<tr>
<td>$b_4$ (animals)</td>
<td>0.118</td>
<td>2.24**</td>
</tr>
<tr>
<td>$b_5$ (expenses)</td>
<td>0.079</td>
<td>4.30**</td>
</tr>
</tbody>
</table>

Notes: LogL = -64.75; n = 75 * = 0.10. ** = 0.01 for one-sided tests.

Access to markets has a significant impact on efficiency. As mentioned previously, markets facilitate flows of information that are not available to self-sufficient individuals. Moreover, production for markets may give rise to increasing returns through specialization, and this may increase resource productivity even without a change in technology. On these farms, increasing returns may thus be related more to market orientation than to overall input quantity as measured by the elasticity of scale, $\eta$.

Food transfers have a positive impact on efficiency. This result is tentative. However, one can probably reject the hypothesis that receipt of food decreases farmer effort. The linkages between transfers and resource allocation at the farm level are probably subtle and involve changing patterns in the use of time of both spouses, changing proportions between cash and subsistence crops, and changing intensity of resource-use due to risk considerations.

**CONCLUSION**

This paper has explored the impact of non-traditional factors on the production efficiency of small farms. Three findings emerge. First, in slash-and-burn agriculture, property rights over land do not appear to influence technical efficiency at the individual farm level. Obviously, over time, shifting cultivation that is characteristic of slash-and-burn systems will cause degradation of production resources. In many areas of the world (including tropical and sub-tropical Latin America), land is relatively abundant and limited-resource farmers are free to move on as the productivity of their current parcel of land decreases.
Second, increased market-orientation is associated with increased efficiency. These results are tentative: although the stochastic frontier model separates random factors from managerial inefficiency, it is possible that this separation is not complete. For example, marketable surplus may increase with favourable random weather shocks, thus confounding the effects of variables \( v \) and \( u \) in Equation (1). Lastly, food transfers appear to increase efficiency of production. Whether this is due to better nutrition or more possibilities for specialization is an important topic for future research.

NOTES

1 This could also occur when demand for output at the individual farm level is highly inelastic. High transactions costs could lead to this situation.
2 PAN (‘bread’ in Spanish) is the acronym for the ‘Programa Alimentario Nacional (National Nutritional Programme). This programme was implemented in the mid-1980s as a direct support to low-income families.
3 Ideally, MA should be measured by variables such as costs of transportation (a function of distance to markets, type of roads, etc.), farmer education and extension contacts. This information, however, is not available.
4 The value of food transfers is obtained by pricing all ‘PAN’ food boxes received by the household.

REFERENCES

INTA Misiones, 1988, Investigación en Chacras de Pequeños Productores de la Provincia de Misiones (Research in Farms of Small Producers of the Province of Misiones), Mimeo.
DISCUSSION OPENING — Csaba Forgacs (Budapest University of Economics)

The efficiency issue is one of the most exciting topics among agricultural economists all over the world. The competitiveness of farmers basically depends on economic efficiency and we would like to know more about the influence of separate factors on it. Substantial research work has been devoted to limited-resource farmer decision-making. But what models are appropriate to measure the results? The simplified input–output models, models based on systems theory and the holistic approach reflect different levels of complexity of agricultural performance. In the literature less attention is paid to the effects of the non-traditional factors on efficiency. An advantage of this paper is that it focuses on three institutional factors and investigates them as determinants of technical efficiency of production: property rights; access to markets, and in-kind income support programmes. It argues that slash-and-burn down agricultural systems allow non-owners of land to operate as efficiently as landowners, or more efficiently.

Studies dealing with subsistence farming mainly focus on low-income countries. This case is an exception by selecting a middle-income country, Argentina, for a case study. The data series collected permits analysis of issues dealing with tenancy, market access and income support in the case of 75 farms. Twenty-seven percent of the farmers owned the land while the rest are squatters, occupying illegally either privately or publically owned land.

As the paper says, production theory suggests that small firms should generally experience increasing returns to additional resources. However, in this case decreasing returns to scales are observed. The explanation is ‘...in the case of labour-intensive production such as analyzed here, factors associated with technology, choice of activity and production specialization can have more impact than duplication of resources. The insignificant coefficient for land is probably characteristic of slash-and-burn, small-farmer agriculture’.

Surprisingly, the results show that land ownership is not significant in determining efficiency. This contradicts the results of other studies which found a positive relationship between property rights and efficiency. Elastic supply of land is used as the explanation. There is a significant positive relationship between market access and efficiency. The increasing level of production for markets may lead to increasing returns through specialization, which may have a positive effect on productivity.

The authors point out that ‘...in slash-and-burn agriculture property rights over land do not appear to influence technical efficiency at individual farm level’ but admit that shifting cultivation is a characteristic of this system which will cause degradation of productive resources. Theoretically, there may be a contradiction between the two statements. The first is true if we use a static approach. But using a dynamic model, this statement would mean that in regions with abundant land, farmers are not interested in becoming landowners. With degradation of the land resource due to the slash-and-burn production, returns to land will decrease over time.

Although it was shown that market access has a positive effect on technical efficiency, the paper mentions that this result is a tentative one. Does it mean that market access can increase efficiency under given circumstances only? If the answer is yes, then what is the explanation?
Finally food transfers are shown to have a positive influence on production efficiency. But can we state that the bigger the food transfers, the higher the positive influence on technical efficiency of production? At this point, the authors underline the necessity for future research.