Education as an Input in Agricultural Production: Argentina

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I. INTRODUCTION

This paper deals with human capital and firm-level performance in agriculture. In this sector firms are comparatively small. Management, capital provision and labor supply are concentrated on one individual and his immediate family. Many tasks have to be done, and decisions have to be worked out and carried through. Mistakes are made, not only on what crop variety to plant, but also on how much land and capital to allocate to different activities. Difficulty in decision-making is compounded by the impact of climatic variability on resource productivity. Indeed, in agriculture, a given input bundle can result in very different output levels according to the level at which random factors operate. Uncertain resource productivity coupled with imperfect capital markets result in a "bad" year seriously compromising the flow of funds to the household.

Attention is focused here on the "pradera pampeana" (prairie of the Argentine *pampas*) , which comprises the main production area of Argentina. To the author's knowledge, only one previous paper (Gallacher, 1999) has addressed the issue of human capital-agricultural production in Argentina. This paper advances on previous work in one important aspect: the data used constitutes a 10 % random sample drawn from records of the 1988 Agricultural Census (Censo Nacional Agropecuario 1988). Some 5300 firms constitute the data set. The questions to be addressed are: (1) Does farmer education affect production efficiency (2) Do returns to education depend on firm technology, and lastly, (3) What are the economic returns associated to different educational levels, and how do these returns compare to those found, in Argentina, in the non-agricultural sector. The paper also attempts to make inferences regarding the interaction between human capital and returns to scale to (conventionally measured) factor inputs.

II. ARGENTINE AGRICULTURE - THE DECISION-MAKING ENVIRONMENT

In the 1970-1994 period availability of new inputs allowed significant increases in output and land productivity (Table I). During the 1970's "green revolution" wheat varieties, hybrid sunflower and (in particular) diffusion of the soybean crop radically changed the alternatives open in crop production. Pre-planting and pre-emergence herbicides, as well as new seeds appeared during the 1980's. These changes occurred at a time of chronic macroeconomic instability: between the mid-1970's and early 1990's Argentina had the doubtful privilege of being one of the countries of the world with highest inflation. [1]

In the *pradera pampeana* firms engage in multioutput production. Intuition suggests (and some research confirms) that difficulty in decision-making increases with the number of outputs that comprise the firm's production plan. Multi-output production reduces managerial specialization and increases learning costs. In multi-output firms linkages exist *between* activities, and these often require significant managerial attention. Linkages include transfer of intermediate (non-market) "goods" such as crop residues and soil fertility, and "bads" such as weeds, pests or water depletion. Intermediate inputs are more difficult to meter than inputs purchased in the market, and have lagged impacts over time the consequences of which are seldom obvious.

Human capital levels in rural areas lag behind those found in urban settings. The 1980 census of population reports that for the central provinces of the *pradera pampeana* only 35-45 percent of adults of rural areas completed primary education, as compared to 55-60 percent of those of urban locations (Table II). Economic policies prevalent since the late 1930's may have been responsible for part of the human capital drain from agriculture to the rest of the economy. Indeed, low agricultural prices (result of export tariffs) and high prices for inputs (due to policies protecting local industry) had as a consequence farm incomes that were lower than would have otherwise been the case.

III. HUMAN CAPITAL AND PRODUCTION EFFICIENCY

The production efficiency literature (e.g. Fried, Knox Lovell and Schmidt, 1993) provides a taxonomy useful for analyzing the impacts of education on firm-level performance. A distinction is made between "technical" and "allocative" efficiency dimensions. The former refers to producing the maximum physical output given an input bundle. In turn, the latter focuses on the extent to which a decision-maker chooses (a) an input combination to minimize cost, (b) output combinations to maximize revenue and (c) the efficient scale of production.

Previous research (see, e.g. Huffman, 1974; Petzel, 1978) finds a positive impact of human capital on allocative efficiency in agriculture. In particular, education shortens the time needed to "adjust" to changes in production options and/or price ratios. Findings generally accord with T.W. Schultz's early assertion of education as an "ability to deal with

[1] High inflation is accompanied by a significant increase in *relative* price variability. Thus, choosing minimum-cost and maximum revenue factor and product combinations is less likely during inflation than

disequilibrium" (Schultz, 1975). For Argentina, Gallacher (1999) working with "partido" ("county") level data failed to find a linkage between human capital and TFP growth between 1970-79 and 1980-89 periods. This result is unexpected, given that the area studied (the central *pradera pampeana*) is very similar to U.S. regions where human capital-efficiency linkages have clearly been demonstrated.

Efficient input and output combinations are better achieved by more educated managers. However, education may be more important as it relates to optimum *scale* of production. One possibility is that decreasing or eventually constant returns give way (up to some output) to increasing returns as the education level of the manager increases. Optimum firm size is therefore contingent on education (see Welch, 1978). The education-size linkage, however, is complex: better educated managers are more "efficient" as farmers but they also face a higher opportunity cost in non-farm activities.

A manager that lacks know-how may consider tapping into the brains of others.[2] In particular, publicly-funded "extension" (technical advice by public employees) provides know-how to agricultural managers. This knowledge can be a substitute or a complement to the agricultural firm's human capital stock. Some work has been done on the impact of extension (e.g. Huffman mentioned above). However this work is scant given the magnitude of public resources allocated to extension services. In Argentina a significant debate revolves around the convenience of increasing resource allocation to INTA (Instituto Nacional de Tecnología Agropecuaria), the national research and extension agency. Rates of return for some research programs has been estimated; however to our knowledge no returns to extension programs have yet been reported.[3] Public extension is not the only source of "outside" human capital. Indeed, in Argentina larger firms frequently employ private technical and management consultants. Consultants, however, may only act as a substitute for the owners management time: an "auditing" and control mechanism and not only (or necessarily) an improved channel for information uptake (Gallacher, Goetz and Debertin, 1994). The impacts of consultants on production is then of interest not only to consultants, but to universities which attempt to gear supply of graduates with market demands.

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during periods of price stability. Inflation also hinders the development of futures markets, of considerable importance as price prediction mechanisms for the agricultural sector.

[2] Ths raises an interesting issue: advice-seeking requires perception of a "need to know".

[3] The anual budget of INTA is some 100 - 150 million dollars.

IV. EMPIRICAL ANALYSIS

IV.1 Data

Ideally, a "panel" (pooled cross-section/time-series) data set should be used to estimate firm-level efficiency. Panel data incorporates price variation through time, which allows attention to be focused on resource use adjustment as a function of selected variables (e.g. human capital). The available data set, however, is only a 1-period cross-section.

Data used for empirical analysis corresponds to a 10 % random sample drawn from the *Censo Nacional Agropecuario 1988*. From the total sample (n = 17,757) a subsample of 5,284 firms was selected. These are farms that produce at least some crop output (pure livestock farms are excluded). Observations with "abnormal" input or output values are also discarded. Table III reports summary statistics. Education levels I through IV refer, respectively, to incomplete primary education, complete primary, complete secondary and complete tertiary (university).

As expected, more educated farmers manage larger production units, size being defined both as land area as well as crop output. However, total investment in fixed capital (farm machinery) shows a less than proportional increase with education. This may be caused by (a) the "lumpiness" of agricultural capital inputs or alternatively (b) managers with higher educational levels choose to contract machinery services instead of owning these assets and producing services "in-house". In the area studied here, a vigorous market exists for these services, driving prices close to minimum average cost. Higher educated managers (see below) may well choose to economize on supervision time by "vertically dis-integrating" some production processes.

A priori one would expect higher returns to education in crop as opposed to livestock activities. Availability of new inputs (and hence opportunities for improved decision-making) appear to be more prevalent in crops than in animal production.[4] However, in the sample no clear relationship exists between education and allocation of land to crops. The issue is complicated by the fact that some activities (e.g. crops) require more intensive supervision; hence even if returns to allocative ability are high, opportunity cost (off-farm marginal income) of this supervision may exceed on-farm returns. Livestock production, although offering reduced opportunities for decision-making may economize on scarce managerial time. Managers with off-farm demands for their time may in fact prefer processes where the *timing* of visits to the farm for information-gathering can be partially chosen; versus processes where

[4] TFP growth has generally been higher in crop than in extensive cattle (particularly calf) production (Gallacher, 2000). TFP growth levels in different activities suggest opportunities for information-

information gathering has to be done at random moments, therefore interfering more severely with the allocation of time to non-farm purposes. [5]

The development literature reports many studies where tenant farmers are relatively poor and have low educational levels. Land ownership is associated with wealth; and obviously then with education. In contrast, in Argentina land tenancy (percentage of land ownership) does not appear to be a monotonic function of education. The relationship, if any, is convex: land ownership is highest in the lowest and highest educational levels. It can be argued that land rental provides the most important outlet for "managerial talent" in agriculture: output can be increased without incurring in rapidly declining marginal productivity (which would occur if land area is held constant and additional variable inputs are applied to this land). Land rental allows individuals to capitalize on specialized knowledge of local production conditions, as well as on bargaining abilities. *Ex-post* analysis of the data of Table III would suggest some support for the above reasoning: increased education (from level I to level III) allows farm expansion to proceed through land rental. However when education attains level IV (university graduates) land rental appears less attractive due to the high cost of managerial time: instead of expanding farm size, managers appear to increasingly prefer non-farm income opportunities.

A substantial increase in off-farm work is associated with higher levels of education. The frequency of *salaried employment* increases from 4.5 % in education class I to more than 19 % of farmers in education class IV. This increase occurs even when total resources for farm production increase: the higher wage rate in off-farm employment more than offsets the higher in-farm marginal product of managerial work that can be expected when production resources (land) increase fourfold between education class I and III. Table III also shows that self-employment increases even more than wage employment; self employment at the highest educational level is also considerably more important than employment for wages. The pattern of education as an "allocative factor" (Schultz, 1975) allowing entrepreneurial decision-making appears to find support in this table.

Some 20 percent of farmers in the lowest education group receive some form of professional advice. For the farmers with the higher educational level, the relevant figure is nearly 70 percent. Private "consulting" services appear to be more important than public (free) extension services. This is true even for the small farm. These results are surprising: conventional wisdom suggests that farm firms are too small to be able to pay for private information sources. The data in Table III does not allow inferences to be made on the *intensity* of consultants used: a consultant may be hired on a regular or on a sporadic basis (e.g. to recommend chemical treatment for weed or pests). Moreover, private provision of information

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gathering and decision-making: activities with low TFP growth representing "static" economic conditions, with low returns to human capital.

may be financed by input suppliers (e.g. seed salesmen) and not directly by the farmer. Nevertheless, the importance of privately funded information transfer mechanisms raises interesting issues relative to the role of public agencies (such as INTA) in supporting agricultural production.

IV.2 Education and Firm-Level production

Farm output may be expressed as a function of selected inputs and environmental factors:

(1) $Y = f(\boldsymbol{X}, \boldsymbol{Z}, \boldsymbol{D})$

Where Y stands for crop output, and the vectors $\boldsymbol{X}$, $\boldsymbol{Z}$ and $\boldsymbol{D}$ stand, respectively, for conventional production inputs ($\boldsymbol{X}$), characteristics of the firm's production plan ($\boldsymbol{Z}$) and environmental and additional factors ($\boldsymbol{D}$) determining production. Vector $\boldsymbol{Z}$ refers to two aspects: (a) the extent to which the firm is single or multiple output, and (b) the importance, in the activity mix, of "new" crops (oilseeds). Specific variables used in estimation are described in the appendix. A conventional Cobb-Douglas function is used here to model production technology. Using lower-case to denote natural logs the function to be estimated is:

(2) $y_i = \alpha + \Sigma_{j=1,5}\, \beta_j\, x_{ij} + \gamma_1\, z_{i1}\, x_{i5} + \gamma_2\, z_{i2}\, x_{i5} + \Sigma_{j=1,8}\, \alpha_j\, D_{ij} + \varepsilon_i$

where, for the i-th observation:

x_1 = land

x_2 = family (unpaid) labor

x_3 = hired labor

x_4 = production expenses

x_5 = education

z_1 = diversification index

z_2 = importance of oilseeds

D_1 and D_2 = use of private/public consultants

D_3 and D_4 = time allocation to non-farm activities (part of the year, year round/full time)

D_5 - D_8 = zone-specific dummy variables

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[5] For managers living off-farm a significant issue is the extent to which production processes can be "remotelly-controlled", using as a link semi-skilled labor that resides on-farm.

Dummy variables D take into account unobserved factors of five production regions (D_5 - D_8). The also include the use or not of private consultants and public extension services (D_1, D_2; yes = 1), and the manager's time being allocated full or part-time to farming (D_3, D_4; part-time = 1).

Variables z_1 and z_2 are included in an effort to estimate the impact (if any) of the firm production plan on returns to education. The formulation corresponds to one where the output elasticity of education is:

(3) $\beta_{educ} = \beta_5 + \gamma_1 z_1 + \gamma_2 z_2$

Variable z_1 represents the extent to which the production plan is single- or multiple-output. For each firm, a "Herfindahl" production diversification index is computed, using the shares of each crop output (squared) in place of the market shares of firm sales (squared) that is used when calculating the conventional Herfindahl index in IO studies. For farms that could engage in a maximum of 5 crop activities, this index is bounded in the interval [0.20, 1.00]. The implied hypothesis is that $\gamma_1 < 0$: returns to education are greater in multiple than in single output production.

Not all production activities entail similar complexity in decision-making. Table I commented above shows that output growth for oilseeds has been much greater than for cereals. The hypothesis tested here is that adjustment in techniques of oilseed production entail higher-order skills than those needed for cereals. Schultz's "adjustment to disequilibrium" concept suggests greater allocative errors in newer activities: oilseed production in Argentina is one such case. Variable z_2 captures is the ratio between oilseed and total output, as such it is a proxy for the "difficulty" of decision-making, or the extent to which adjustment has to be made to new production procedures. The hypothesis is then : $\gamma_2 > 0$.

IV.3 Estimation Results

Table IV reports estimation results. All partial elasticities of production inputs have the expected sign and are significant (p = 0.10). The fact that only very rough measures of non-land inputs was available probably explains the "high" partial elasticity of the land input (0.65). This value probably overestimates the "true" elasticity of land.[6]

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[6] Share of land rent in total cost of production typically ranges in the 0.35 - 0.45 interval. Assuming a Cobb-Douglas technology, constant returns to scale and cost-minizing behavior, share of cost of a given

Hypothesis related to the human capital input are not rejected. In particular:

1. Education is positively associated with production.

2. Returns to education decrease with a decrease in the degree of diversification of the production plan.

3. Returns to education increase with an increase in the importance (as measured by share in total revenues) of oilseed crops.

This last finding lends support to the hypothesis that education is basically an input useful for dealing with rapid change. Further, the interaction between output type is both highly significant as well as important in an absolute sense: the elasticity of education will increase .22 points in firms with 100 % as compared with 50 % of revenues from oilseeds. In summary, management skills are stressed by the *type* of activity that the firms engages in, as well as by the *number* of activities.

The sum of elasticities of inputs X_1 - X_4 represent the "returns to scale parameter" that results when input X_5 (human capital) is held constant. If the elasticity of input X_5 is added, the "correct" returns to scale value is obtained (response to proportional increase in all inputs). Denote by η_1 and η_2 these two alternative definitions of scale returns. Estimation results of Table IV imply $\eta_1 = 0.93$ and $\eta_2 = 1.24$. The F-test comparing these values with 1 results in the hypotheses test of constant returns being rejected for η_1 ($p = 0.083$) as well as for η_2 ($p = 0.0796$). That is, an increase in "conventional" inputs (education held constant) results in a less than proportional increase in output. On the other hand if education as well as conventional inputs are increased, output increases more than proportionally. These results suggest that optimum firm size increases with an increase in the manager's human capital.

Production function results allow comments to be made on the magnitude of returns to education in the agricultural as compared to the non-agricultural sector. Pessino (1995) estimates returns to education for urban workers in Argentina. In this study, the basic function for estimating the relationship between human capital and wages was (Pessino, page 4):

$$(4) \quad \ln w_i = \ln w_0 + \beta_1 s_i + \beta_2 X_i + \beta_3 (X_i)^2 + u_i$$

where w_i represents the wage of the ith individual, w_0 the base-level wage, and s_i and X_i measures of years of schooling and work experience. Wage equations fitted to 1991 data (Pessino, Table 3-D, eq.1) allow estimates of wage increases due to education to be obtained.

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input in total cost equals the partial elasticity of production of the input. The econometric estimate of partial elasticity (0.65) thus appears nearly double of what one would expect (0.35 - 0.45).

For example, an extra year of education (at the sample averages of education and work experience) results in an 10.5 percent increase in wages.

Table V shows estimates of increases in output associated with a 1 year increase in education. Firm resource use corresponds to sample means. These increases average $/year 680 (pooled prediction for all production areas), with a maximum (in Area 1) of $/year 1308.[7] The table also reports lower and upper-bound estimates of increases in output as a percentage of the opportunity cost of base-level managerial time. The appendix details the assumptions behind these percentage return figures: $100*\Delta Y/(\alpha W_m)$, where ΔY = increase in farm output resulting from a 1-year increase in education, W_m = a measure of (anual full-time) managerial opportunity cost, and α is the proportion of anual time managing the agricultural operation under consideration.

For the average of all areas, these estimates range from 7.3 (lower bound) to 14.6 percent (upper bound). Pessino's estimate of 10.5 percent wage increase for urban workers fits tidily between these estimates of the impact of education in agricultural production. Of course, these figures do not allow precise inferences to be derived on incentives for intersectoral allocation of human capital (absolute rather than percentage increases in income would be necessary for this). However, the data shown suggest that returns to education in agriculture are (on average) similar to those in non-agricultural activities.

Allocation of time to off-farm activities is associated with lower on-farm productivity. For example, year-round off farm work results in a reduction in output of some $/year 4,800. This figure corresponds to approximatelly 52 percent of the rough measure of off-farm wage opportunity for farm managers ($/year 9,300).

Results also show that the use of private and public consultants has an impact on production. The elasticity of public-sector extensionists is greater than that of private consultants. This results is somewhat surprising, given that costs are involved in accessing the latter: consultant fees are explicit costs of private information sources; valuable managerial time is an implicit cost in interacting with both private as well as public information purveyors. In a average sized farm (some 120 crop hectares) hiring a consultant represents an yearly income increase of $ 1,250. This figure is modest; however "scaling up" crop area from 120 to 1,200 hectares would result in anual returns of some $ 12,000. This figure is probably more than double the anual cost of a monthly half-day consultant visit.

[7] Monetary figures correspond to March 2001 Argentine pesos ($1 = US$ 1).

V. Conclusions

This study shows that education is a significant input in agricultural production. The absolute magnitude of returns to education depends not only on the geographical location of the firm but on the extent to which the firm is single- or multiple- output. Education is an especially important input when the firm engages in activities that involve more complex decision-making. In Argentine agriculture, oilseeds appear to be such a case. "Returns" to education (estimated here as percentage increases over opportunity wages) obviously depend on firm size. For the average firm, these returns are very similar to those reported by researchers for urban workers.

Returns to education in larger-sized farms are higher than those reported here. The "average" farm size used in calculations is considerably smaller than that corresponding to farms that can be expected to survive in the next decades. Further, this paper shows that if education is held constant, decreasing returns to scale apply, whereas allowing education to vary results in increasing returns to all inputs (including education). A future paper will address the size-education linkages in more depth.

Both allocating time to non farm activities, as well as hiring consultants have impacts on output achieved per unit of (conventionally measured) inputs. The drop in output resulting from non-farm occupations is quite large: nearly half the annual pay of a non-farm workers. Returns associated with private consultants are not large in averaged sized farms, but probably well exceed their cost in larger operations.

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APPENDIX: DATA SET

Individual firm-level observations comprise the data set. A 10 % random sample was selected. Observations used for analysis meet the following criteria: (1) non-zero value reported for labor, education, crop output and crop acreage. Additional conditions were imposed in order to eliminate observations with errors and/or "abnormal" farms. The resulting sample inluded 5,284 of the original 17,757 observations.

The following variables were used in the analysis:

Crop Output (***y***) $\Sigma_{i=1,\,5}$ r_i ha_i where r_i = output per unit of land of the i-th crop, planted acreage of the i-th crop (wheat, corn, sorghum, sunflower, soybeans), ha_i= hectares planted of the -th crop.

Crop acreage (x_1) An estimate of crop area was obtained with an auxiliary regression. Harvested area ($\Sigma_{i=1,\,5}$ ha_i) was expressed as a function of total farm size (linear and quadratic terms), percentage land ownership, cattle numbers and area-specific dummies. This indirect approach was chosen in order not to use as an independent variable $\Sigma_{i=1,\,5}$ ha_i, a scalar highly correlated with the crop output dependent variable ($\Sigma_{i=1,\,5}$ r_i a_i) mentioned above.

Family Labor (x_2) Man-equivalents of family labor, weighted by a age-productivity factor (younger than 15 = 0.70, older than 65 = 0.80)

Hired Labor (x_3) Man-equivalents of hired labor, same age-weights as above

Durable Capital: Index obtained by multipying total tractors (in 62 hp-equivalent units) by price of new 62 hp tractor as per *Agromercado* publication.

Production Expenses Index (x_4) Land area receiving chemical inputs (fertilizers, insecticides, herbicides and fungicides) is reported in the census. Aproximate expense per unit of area of each of these inputs was obtained from the *Agromercado* publication. For herbicides, expenses for the five crops were weighted by the participation of each crop in total area. For other inputs, a rough "average" expense was applied for treated area. Chemical input expenses was added to (a) depreciation plus interest on capital (tractor) stock and (b) purchased machinery services in order to abtain a proxy for total non-labor expenses. For purchased machinery services the census reports machinery services (hectares) hired to outside contractors. The services are land plowing/disking, crop protection and harvesting. An estimate of expenses payed to contractors was obtained by multiplying each of these by their market price (source: *Agromercado*)

Human Capital (x_5) The census reports the following education groups: no schooling, primary, secondary, tertiary (university/technical). "No schooling" corresponds to those *that have not completed primary* education. A "years of education" index was obtained by assuming that each of these education groups correspond, respectively, to 6, 9, 12 and 17 years of formal schooling. For example, for those reporting only primary education, the above implies that they have completed this level, and dropped out after two years of high school. This construction of theis index assumes implicitly a linear relation between years of schooling and human capital acumulation relevant to farming.

Human Capital (Consulting/extension use): dummy variables taking the value of "1" for farms using each of these inputs (D_1 = private consultants, D_2 = public extension services)

Time allocation off-farm: dummy variables taking a value of "1" for managers engaged in work outside the farm during part of the year or year-round (D_3 = off-farm work part of the year, D_4 = year round).

Specialization in production: variable z_1 is calculated as: $\Sigma_{i=1,\,5}$ $(s_i)^2$ where represents the share of the i-th crop in total crop revenue. For i=5, $z_1 \in [1, 0.20]$.

Importance of oilseeds: z_2 = Oilseed Revenue/Total Crop Revenue. Oilseeds are sunflower and soybeans, non-oliseed crops are wheat, grain sorghum and corn.

Area-specific dummies: dummies D_5 - D_8 correspond, respectively, to the west and the south-east of the province of Buenos Aires (D_5 and D_6), the "center" region (mainly Córdoba and center of Santa Fé, variable $\boldsymbol{D}_7$) and the rest of the pradera pampeana (variable $\boldsymbol{D}_8$). The main corn-soybean producing area of the country (north of Buenos Aires, south of Santa Fe) corresponds to dummy variable $\boldsymbol{D}_1$ excluded from the regression.

Returns to Education: The percentage increase in managerial income associated with education is estimated as $\Delta Y/(\alpha W_m)$ where ΔY = increase in farm output resulting from a 1-year increase in education, W_m = a measure of (anual full-time) managerial opportunity cost, and α is the proportion of anual time managing the agricultural operation under consideration. ΔY is obtained as the predicted values from the estimated production function. A crude approximation for W_m was obtained from the *Informe Económico*, by assuming that average wage payments for all non-farm workers (in the province of Buenos Aires) represent the opportunity cost of full-time agricultural managers. Available data corresponds to October 1994 (W_m = $/year 9,300; *Informe Económico* 17, Table A.3.3). Two values of α were considered: 0.50 and 1.00. The first assumes that the manager spends 50 percent of his time managing the process represented by the estimated production function. 100 percent time allocation is assumed when α = 1.00. It appears reasonable to measure percentage returns to education for different values of α: (1) crop production is not the only production process, (2) for average-sized farms (some 120 crop hectares) total demand for labor is less than 500 hrs/year, well below the 2000 hrs/year that is computed for one full time worker.

Table I: ARGENTINA - Output and Output per Unit of Land

(1970-74 = 100)

	80-84	90-94
Total Output	205	253
Land Input	124	119
Cereal Output	155	125
Oilseed Output	819	1.733
Total Output/Land	174	212
Cereal Output/Land	147	177
Oilseed Output/Land	241	288

Source: Ministerio de Economía - SAGYP

Table II: Education Levels - Rural and Urban

(Selected Provinces)

Province	Primary Education: Assists	Assisted Incomplete	Assisted Complete
Pradera Pampeana			
Buenos Aires	%	%	%
Urban	16.2	21.4	58.6
Rural	16.3	33.8	43.3
Santa Fé			
Urban	14.8	22.4	58.2
Rural	17.3	35.4	38.3
Cordoba			
Urban	15.7	23.1	56.9
Rural	17.6	39.0	34.5
North-East Argentina			
Chaco			
Urban	20.3	25.6	44.7
Rural	23.3	38.2	15.9
North-West Argentina			
Salta			
Urban	22.9	19.2	52.3
Rural	27.1	35.2	18.3

Source: INDEC-Censo Nacional de Población y Vivienda 1980. Serie D Población

Table III: Human Capital and Firm Structure

		Education Level			
		I	II	III	IV
n		937	3180	655	291
Farm Size					
Land	(ha)	156	229	450	654
Capital	(US$)	26, 108	37,243	43,789	42,329
Output	(US$)	22, 393	41, 410	70,665	74,875
Land Use/Tenancy					
Cropland	(%)	53.8	63.7	62.0	51.1
Own Land	(%)	84.9	76.4	75.3	83.1
Off-Farm Work					
Salaried	(%)	4.5	4.8	10.6	19.2
Self Empl.	(%)	5.2	6.9	12.5	31.6
Use of Outside Information					
Public	(%)	5.0	10.0	18.6	18.2
Private	(%)	14.8	25.2	44.7	50.5

Notes: (1) "Capital" refers to an estimate of investment in tractors

(2) Observations with average farm education of 10 and 16 years of schooling not reported (respectively 196 + 25 observations)

Table IV: Production Function Estimates

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º Ordinary    least squares regression    Weighting variable = ONE       º
º Dependent variable is LVP       Mean =    9.78489, S.D. =      1.5522 º
º Model size: Observations =    5284, Parameters =  16, Deg.Fr. =  5268 º
º Residuals:  Sum of squares=    3689.78     Std.Dev. =         0.83691 º
º Fit:        R-squared = 0.71013, Adjusted R-squared =         0.70931 º
º Model test: F[ 15,   5268] =  860.40,    Prob value =         0.00000 º
º Diagnostic: Log-L =  -6548.8858, Restricted(á=0) Log-L =   -9820.5741 º
º             Amemiya Pr. Crt.=    0.703, Akaike Info. Crt.=      2.485 º
º Autocorrel: Durbin-Watson Statistic =   1.66789,   Rho =      0.16606 º
º Results Corrected for heteroskedasticity                              º
º Breusch - Pagan chi-squared =  1324.1150, with  15 degrees of freedom º
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```

Variable	Coefficient	Standard Error	z=b/s.e.	P[³Z³òz]	Mean of X
Constant	4.577398	0.13246	34.556	0.00000	
X_1 LPHA0	0.6498474	0.22936E-01	28.334	0.00000	4.410
X_2 LTRFAM	0.9181846E-02	0.51249E-02	1.792	0.07320	-2.803
X_3 LTRNOFAM	0.3508595E-01	0.57172E-02	6.137	0.00000	-2.952
X_4 LGD	0.2429508	0.14350E-01	16.931	0.00000	8.407
X_5 LESCOLB	0.5753225	0.39229E-01	14.666	0.00000	1.887
Z_1 ILESC1	-0.8545836	0.26993E-01	-31.660	0.00000	1.368
Z_2 ILESC2	0.4442607	0.19865E-01	22.364	0.00000	0.8245
D_1 ASPROF	0.3988892E-01	0.26549E-01	1.502	0.13298	0.2714
D_2 ASOFIC1	0.1232050	0.34744E-01	3.546	0.00039	0.1069
D_3 PARTT1	-0.2271558	0.60744E-01	-3.740	0.00018	0.5072E-01
D_4 PARTT2	-0.1677285	0.12282	-1.366	0.17206	0.1192E-01
D_5	0.4455203E-01	0.37756E-01	1.180	0.23801	0.1084
D_6	0.2591480	0.37958E-01	6.827	0.00000	0.1573
D_7	0.7527522E-01	0.31305E-01	2.405	0.01619	0.2922
D_8	0.5187187	0.48183E-01	10.766	0.00000	0.1296

Table V: "Returns" to Education

Area	ΔY	Percentage Return LB	Percentage Return UB
	$	%	%
1	1308	14.1	28.1
2	1025	11.0	22.0
3	53	0.6	1.1
4	435	4.7	9.4
5	-209	-2.2	-4.5
All	680	7.3	14.6

"Percentage Return": increase over off-farm opportunity cost.
See Appendix
LB = "lower bound"
UB = "upper bound"