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A NOTE ON Z GOODS, MARKETED SURPLUS AND THE LABOR INTENSITY OF SMALL FARM AGRICULTURE

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The size of agricultural marketed surplus is an important variable in most two-sector models of economic development. This paper suggests that the factor proportions found on small farms may also influence the fraction of total output these farms sell to other sectors. By looking at small farm behavior in the content of the Z goods model originally developed by Hymer and Resnick, this paper tries to provide a precise explanation of the manner in which these variables are linked. Z goods are defined as the heterogeneous bundle of goods that are produced and entirely consumed by the farm unit and which are to some extent substitutable for similar kinds of goods produced in the nonagricultural sector. Small farms are assumed to produce crop and Z goods and to consume these and nonagricultural goods. Crop goods are assumed to require both land and labor in production while Z goods require only labor. A major conclusion from this analysis is that when labor is drained off small farms by growth in off-farm labor demand it is likely that an increased supply of food to other sectors will accompany this factor reallocation and facilitate its continuation.

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A NOTE ON Z GOODS, MARKETED SURPLUS AND THE LABOR INTENSITY OF SMALL FARM AGRICULTURE

By

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A Note on Z Goods, Marketed Surplus and the Labor Intensity of Small Farm Agriculture

1. Introduction

The importance of a marketed agricultural surplus has been emphasized in a number of recent studies of the development process. In the Ranis-Fei and similar labor surplus models it is the size of this surplus relative to the nonagricultural demand for food which determines the intersectoral terms of trade and the ability of an economy to absorb labor in the higher productivity nonagricultural sector.[1] Almost all the literature focuses on the responsiveness of small farm marketed surpluses to relative price variables.[2] Verry little attention has been given to the role that non-price variables may play in affecting the size of this surplus, perhaps because the more obvious ones such as transport improvement can be treated in the first instance as effective price changes for farm products.

This note examines how variations in the labor-land ratio of small farms may affect the size of the marketed surplus these farms provide.[3] Previous studies have probably overlooked the role factor proportions play in determining the size of the surplus because they have emphasized how the marketed output of a single crop

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[1]The argument is presented in detail in J. Fei and G. Ranis, Development of the Labor Surplus Economy: Theory and Policy, Richard Irwin Inc., Homewood, Illinois, 1964.

[2]Two recent articles dealing with price responsiveness in India and briefly summarizing the literature in this area are K. Bardhan, "Price and Output Response of Marketed Surplus of Foodgrains: A Cross-Sectional Study of Some North Indian Villages," American Journal of Agricultural Economics, Vol. 52, no. 1, February 1970, pp. 51-61; and K. Bardhan and P. Bardhan, "Price Response of Marketed Surplus of Foodgrains," Oxford Economic Papers, Vol. 23, no. 2, July 1971, pp. 255-67.

[3]In the Ranis-Fei model total agricultural surplus is inversely related to the labor-land ratio by assuming diminishing returns to agricultural production and a constant agricultural wage rate. However, their model analyzes an agrarian sector dominated by landlord-worker relationships. A different agrarian structure, one characterized by small scale owner-operators (peasants), is taken as the starting point for this note.

usually foodgrains, responds when its price relative to that of other crops changes. Implicitly the small farmer has been envisioned as allocating his resources among competing crops according to their relative returns. A price increase for one crop would stimulate higher output levels of that crop (at the expense of other crops) while on the demand side consumption could rise or fall depending on the relative strengths of the income and substitution effects of the price increase. A sufficiently strong income effect could conceivably result in a backward-bending supply of marketed output.

The possibility that total crop output, as well as crop composition, might be altered has been analyzed thoroughly only by Hymer and Resnick.[1] In their Z goods model they introduce another dimension to small farm decision-making, the allocation of family labor time between agricultural and non-agricultural activities, as an alternative to the more traditional labor-leisure choice. They derive an offer curve of marketed output in which the relevant price variable is the price of crops relative to the price of manufactured nonagricultural goods that serve as close substitutes for the own-production of Z goods. As with the models of intercrop labor allocation they demonstrate that marketed crop output is subject to the conflicting pressures of a positive production effect and a positive substitution and negative income effect in demand when the relative price of crops increases.

This note adopts and extends the framework of Hymer and Resnick to consider how altered factor proportions (the labor-land ratio) influence the amount of marketed output and the welfare of the small farm sector. The Z goods framework is an appealing vehicle for analyzing these issues because it recognizes the rich complexity of rural life. The welfare and marketed output issues themselves are likely, for several

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[1] S. Hymer and S. Resnick, "A Model of an Agrarian Economy with Nonagricultural Activities," American Economic Review, September 1969, pp. 493-506.

reasons, to be of some interest to policy makers. In many countries rapid rates of population growth combined with limited rates of labor absorption in the non-agricultural sectors imply a steadily rising man-land ratio in the small scale agricultural sector.[1] It is generally presumed that when this occurs marketed farm output will decline as farm operations are directed more towards self-subsistence operations.[2] However, the exact mechanism by which this result would occur has never been clearly spelled out. Not surprisingly, in the analysis to follow the matter turns out to depend a great deal on the characteristics of the production functions in the Z and crop activities, an issue not fully explored by Hymer and Resnick. A related question is the extent to which the ability to substitute home production for purchased nonfarm goods can compensate for the reduction in welfare attributable to more people seeking an income from the same amount of land. There appears to be no way in which the Z goods alternative can prevent a decline in rural welfare when there is an increase in the population-land ratio.

The first part of this note presents the theoretical model and establishes sufficient conditions for a decline in marketed surplus in response to a higher man-land

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[1]The specific case of Pakistan has been recently examined by B. F. Johnston and J. Cownie, "The Seed-Fertilizer Revolution and Labor Force Absorption," American Economic Review, September 1969, pp. 569-82. One of the many more general treatments of the problem is by Robert d'A. Shaw, Rethinking Economic Development, Headline Series, No. 208, The Foreign Policy Association, December 1971.

[2]B. F. Johnston and J. Cownie, ibid., p. 575, note that " . . . the establishment of a subsector of large scale units that could satisfy a major part of the commercial demand would mean that the average size of the remaining farm units and their ability to command purchased inputs would be reduced accordingly." On page 576 they add that "the expected increase in the farm labor force would presumably have to be absorbed by the small scale, bullock-oriented subsector where family members join the labor force even though their marginal product may be less than the average product that they consume." C. P. Kindleberger, Economic Development, McGraw-Hill Co., New York, N.Y., 1965, p. 219, asserts that "if population is increasing on the farm, the amount of food available for the city is likely to decline, not merely stand still."

ratio. A by-product of this exercise is a presentation of some of the structural details required to interpret the solutions found in the original paper by Hymer and Resnick. An expression for the welfare change produced by a higher man-land ratio is also provided. The second section is empirical. It surveys the few studies that have noted the presence of Z goods in the Colombian economy and then attempts to explain the behavior of marketed surplus using data collected for a small sample of Colombian farms.

2. The Model

Following Hymer and Resnick, Z-goods are a polyglot collection of homemade items which require the diversion of family labor input from crop production. They consist of a heterogeneous bundle of consumption and investment goods and services including food processing; the making of family clothes; fuel and ceramics; home and farm repairs and improvements; and homemade tools and implements. Although the major item in the small farmer's budget is food, some part of his total expenditure is devoted to nonagricultural goods. Many, but certainly not all, of these nonagricultural goods are close substitutes for products which the small farmer either does or could produce on his own farm with family labor time. Also, because of poor quality or the absence of ready markets, most of these goods are nontradeable so that their entire production must be consumed on the farm which produces them. The small farmer is able to substitute in consumption between home-produced and purchased nonagricultural goods by switching the allocation of family labor between crop and Z goods production. A higher proportion of purchased to homemade nonagricultural goods could be achieved by devoting less labor time to Z goods and more to field work in order to raise the value and volume of marketed farm output needed to buy nonagricultural goods.

The following notation, the same as that of Hymer and Resnick, is used:

F = crop production

$\bar{F}$ = home consumption of crops

Z = collection of nonfood goods, produced but not traded.

M = purchased nonagricultural goods, traded but not produced.

U = collective utility function of the small farm sector.

P = the price of F relative to M, $\frac{P_f}{P_m}$.

L = total labor endowment of the small farm sector divided between the production of F and Z, $L_F + L_z = L$.

Additional assumptions are used to characterize the production and utility functions of the small farm sector. The level of utility depends on the level of consumption of $\bar{F}$, Z and M where each argument in the utility function is written in per capita terms. With an equal distribution of all consumption goods and identical tastes, any utility level can be interpreted as the common level of welfare per member of this sector. Crop production is assumed to employ two inputs: labor and a fixed amount of land. The returns to labor in crop production are therefore assumed to display diminishing returns according to the production function $F = G(L_f)$. Since the major, if not exclusive, input in Z-goods production is family labor time, the output of Z is assumed to occur with constant marginal productivity according to the production function $Z = aL_z$, where the coefficient a measures the constant marginal and average product of labor in Z. By generating a positive marketed surplus of crop production, the small farm sector can exchange food for nonagricultural goods. If intersectoral trade is assumed to be balanced, this opportunity for trade can be expressed by the constraint $\{M - \frac{P(G\{L_f\} - \bar{F})}{L}\} = 0$.

The small farm sector can be viewed as attempting to maximize its utility subject

to its production function and trade constraints. Optimizing the Lagrangean expression

$$\varphi = U(Z, \overline{F}, M) - \lambda \{M - P(\frac{G\{L_f\}}{L} - \overline{F})\}$$

gives rise to four first-order conditions:

$$(1) \quad U_z + \frac{\lambda PG'}{a} = 0$$

$$(2) \quad U_{\overline{f}} + \lambda P = 0$$

$$(3) \quad U_m + P = 0$$

$$(4) \quad M - P(\frac{G\{L_f\}}{L} - \overline{F}) = 0$$

These conditions differ from those usually generated by an intersectoral trade model due to the interdependence of production and consumption decisions. A two-stage sequence of maximizing the value of production and then maximizing utility through trade does not happen in this model because of the inseparability of these two types of decision.

From this model Hymer and Resnick used the above set of conditions to analyze reactions to altered terms of trade P.[1] Here they are used to determine the direction of reactions to an altered man-land ratio. Letting G' and G'' denote the first and second derivatives of the production function in crops and using subscripts for all other partial derivatives, the first-order conditions, (1) to (4), can be totally differentiated with respect to the labor endowment L to yield the following system of equations:

[1] S. Hymer and S. Resnick, "A Model of an Agrarian Economy with Nonagricultural Activities," The American Economic Review, September 1969, pp. 493-506.

$$(5)\quad \begin{bmatrix} U_{zz} & U_{z\bar{f}} & U_{zm} & \frac{PG'}{a} \\ U_{\bar{f}z} & U_{\bar{f}\bar{f}} & U_{\bar{f}m} & P \\ U_{mz} & U_{m\bar{f}} & U_{mm} & 1 \\ \frac{PG'}{a} & P & 1 & 0 \end{bmatrix} \cdot \begin{bmatrix} \frac{dZ}{dL} \\ \frac{d\bar{F}}{dL} \\ \frac{dM}{dL} \\ \frac{d\lambda}{dL} \end{bmatrix} = \begin{bmatrix} -\frac{G''}{a}\frac{L_f}{L}P\lambda \\ 0 \\ 0 \\ \frac{P}{L^2}(G'L_f - G) \end{bmatrix} + \begin{bmatrix} \frac{P\lambda G''}{a^2}\frac{dZ}{dL} \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

In order to simplify the notation, let

$$A = -\frac{G''}{a}\frac{L_f}{L}P\lambda$$

$$B = \frac{P}{L^2}(G'L_f - G)$$

$$C = \frac{P\lambda G''}{a^2}$$

Notice that because $G'' < 0$ and $\lambda < 0$, $A < 0$; $B < 0$; and $C < 0$. If D is the determinant of the first matrix in (5) and D_{ij} is the co-factor of the element in the i'th row and j'th column of D, the implicit solutions of the system can be set out in equations (6) to (8).

$$(6)\quad \frac{dZ}{dL} = A\left(\frac{D_{11}}{D}\right) + B\left(\frac{D_{41}}{D}\right) + C\left(\frac{D_{11}}{D}\right)\frac{dZ}{dL}$$

$$(7)\quad \frac{d\bar{F}}{dL} = A\left(\frac{D_{12}}{D}\right) + B\left(\frac{D_{42}}{D}\right) + C\left(\frac{D_{12}}{D}\right)\frac{dZ}{dL}$$

$$(8)\quad \frac{dM}{dL} = A\left(\frac{D_{13}}{D}\right) + B\left(\frac{D_{43}}{D}\right) + C\left(\frac{D_{13}}{D}\right)\frac{dZ}{dL}$$

These solutions have a direct interpretation in terms of a Slutsky equation. For any solution, the first term measures the substitution effect in consumption with total

utility constant as the higher man-land ratio alters the comparative advantage of producing F and Z. The second term measures the income effect of a higher man-land ratio holding the marginal productivity ratio $\frac{G'}{a}$ constant. As will be shown later on, it is the second term which measures the welfare loss associated with a larger amount of labor per unit of land. The third term is what Hymer and Resnick have dubbed the curvature effect which would be zero if the relative marginal productivities, G' and a, did not change in response to changed factor proportions.

Evaluating these terms for each solution note that, from the second-order conditions for a relative maximum, D must be negative for the existence of a stable equilibrium.

$$D_{11} = P\,(U_{m\bar{f}} - PU_{mm}) - (U_{\bar{f}\bar{f}} - PU_{\bar{f}m}) > 0.$$

Thus, $D_{11}/D < 0$ and $A\,(\frac{D_{11}}{D}) > 0$ or a positive substitution effect.

$$D_{41} = -\,(U_{z\bar{f}}U_{\bar{f}m} - U_{zm}U_{\bar{f}\bar{f}}) - P\,(U_{z\bar{f}}U_{mm} - U_{zm}U_{m\bar{f}}) + \frac{PG'}{a}\,(U_{\bar{f}\bar{f}}U_{mm} - (U_{\bar{f}m})^2)$$

and because

$$U_{\bar{f}\bar{f}}U_{mm} - (U_{\bar{f}m})^2 > 0$$

from the second-order conditions, $D_{41} < 0$. Therefore $\frac{D_{41}}{D} > 0$ and $B\frac{D_{41}}{D} < 0$. If the positive substitution effect outweighs the negative income effect, <u>per capita</u> Z consumption might rise, given that the third term changes sign as $\frac{dZ}{dL}$ changes sign.

Complementarity or substitution in consumption is conventionally defined as the nature of the change in the marginal rate of substitution between two goods with respect to a change in consumption of any good purchased by a consumer. For instance, if

$$\frac{\partial}{\partial \bar{f}}\left(\frac{U_z}{U_{\bar{f}}}\right) > 0,$$

$\bar{F}$ and Z are complements in consumption, and if

$$\frac{\partial}{\partial \bar{f}}\left(\frac{U_z}{U_{\bar{f}}}\right) < 0,$$

$\bar{F}$ and Z are substitutes in consumption. With this criterion in mind,

$$D_{12} = - P \left(U_{mz} - U_{mm} \frac{PG'}{a}\right) - \left(U_{\bar{f}z} - U_{\bar{f}m} \frac{PG'}{a}\right) .$$

The first term above is always negative while the second term, substituting for $\frac{PG'}{a}$, will also be negative if Z and $\bar{F}$ are substitutes in consumption. If Z and $\bar{F}$ are complements in consumption, D_{12} could be positive. Therefore, $A\left(\frac{D_{12}}{D}\right) \lesseqgtr 0$ as $D_{12} \gtreqless 0$.

$$D_{42} = \left(U_{zz} U_{\bar{f}m} - U_{am} U_{\bar{f}m}\right) - P \left(U_{zz} U_{mm} - (U_{mz})^2\right) + \frac{PG'}{a} \left(U_{mm} U_{\bar{f}z} - U_{\bar{f}m} U_{mz}\right)$$

which is always negative since the second term is negative from the second order conditions. Thus, $\frac{D_{42}}{D} > 0$ and $B\left(\frac{D_{42}}{D}\right) < 0$.

The last solution is the change in <u>per capita</u> purchases of nonfarm goods, or, equivalently, in <u>per capita</u> marketed surplus in response to a higher man-land ratio.

$$D_{13} = - \left(PU_{\bar{f}z} - U_{\bar{f}\bar{f}} \frac{PG'}{a}\right) + P^2 \left(U_{mz} P - U_{m\bar{f}} \frac{PG'}{a}\right)$$

and the first term is always negative as is the second if Z and M are substitutes in consumption. If $D_{13} < 0$, $\frac{D_{13}}{D} > 0$ and $A\left(\frac{D_{13}}{D}\right) < 0$.

$$D_{43} = - \left\{\left(U_{zz} U_{\bar{f}\bar{f}} - (U_{z\bar{f}})^2\right) - P \left(U_{zz} U_{m\bar{f}} - U_{mz} U_{z\bar{f}}\right) + \frac{PG'}{a} \left(U_{\bar{f}z} U_{m\bar{f}} - U_{\bar{f}\bar{f}} U_{mz}\right)\right\}$$

which is always negative since $U_{zz} U_{\bar{f}\bar{f}} > (U_{z\bar{f}})^2$ by the second-order condition. Therefore $D_{43} < 0$, $\frac{D_{43}}{D} > 0$ and $B\left(\frac{D_{43}}{D}\right) < 0$.

The following are a sufficient, but not necessary, set of conditions which will translate the effects of a higher man-land ratio into higher <u>per capita</u> Z, slightly lower <u>per capita</u> $\bar{F}$ and a significantly lower <u>per capita</u> M:

(a) The positive substitution effect for $\frac{dZ}{dL}$ outweighs the combined negative income and negative curvature effects.

(b) Z and $\bar{F}$ are complements in consumption.

(c) Z and M are substitutes in consumption.

(d) No consumption good is inferior.

These conditions possess a high degree of empirical plausibility. If they are satisfied the adjustment of the small farm sector to a higher man-land ratio will likely involve a movement in the direction of greater self-sufficiency. This outcome is dictated by a shift in the structure of comparative advantage in favor of more home production and consumption of Z goods and less production of marketable food goods.

The foregoing can also be used to demonstrate the welfare loss incurred by the small farm sector as a result of a higher man-land ratio. The change in welfare of this sector can be expressed as

$$\frac{dU}{dL} = U_z \frac{dZ}{dL} + U_{\bar{f}} \frac{d\bar{F}}{dL} + U_m \frac{dM}{dL} .$$

Substituting into this expression the solutions for $\frac{dZ}{dL}$, $\frac{d\bar{F}}{dL}$ and $\frac{dM}{dL}$ results in

$$\begin{aligned} \frac{dU}{dL} = {} & A \left(U_z \frac{D_{11}}{D} + U_{\bar{f}} \frac{D_{12}}{D} + U_m \frac{D_{13}}{D}\right) + \\ & B \left(U_z \frac{D_{41}}{D} + U_{\bar{f}} \frac{D_{42}}{D} + U_m \frac{D_{43}}{D}\right) + \\ & C \frac{dZ}{dL} \left(U_z \frac{D_{11}}{D} + U_{\bar{f}} \frac{D_{12}}{D} + U_m \frac{D_{13}}{D}\right) . \end{aligned}$$

Since the first terms in each solution are evaluated at a constant level of utility, it is easy to show that

$$U_z \frac{D_{11}}{D} + U_{\bar{f}} \frac{D_{12}}{D} + U_m \frac{D_{13}}{D} = 0$$

so the first and last terms above vanish. This leaves only the middle term which, as the above analysis indicates, is the unambiguously negative sum of all the different income effects. Therefore, ignoring unrealistic corner solutions, the small

farm sector must always be worse off with a higher man-land ratio. The basic reason for this result is that a higher man-land ratio causes a shrinkage in the *per capita* production possibilities of the small farm sector. *Per capita* income is a weighted average of labor productivity in Z and F production and only Z production enjoys constant labor productivity. Thus even if all of the extra labor were allocated to crop production the average amount of food output per member of the labor force would decline. Only if all small farm labor, additional and initial amounts, were allocated to Z production would a welfare loss fail to materialize. This case, however, represents an implausible situation in which tastes are so skewed towards Z that a corner solution of zero production and consumption of food occurs.

3. Empirical Results

This section seeks empirical confirmation of the hypothesis in the preceding section, that the marketed surplus of food production on small farms is likely to be inversely related to the ratio of labor to land on these farms. Since the data refer to small farms in Colombia, it is desirable to consider first the relevance of Z goods in a Colombian context. Most studies of small farm production and consumption have alluded only briefly to their prominence in the rural economy and do not assess their importance in the total income of the small farmer. The existence, however, of Z goods on at least some small farms is beyond doubt. Grunig, for instance, mentions that any excess of crop output beyond home-consumption and the provision of next year's seed went for the purchase of clothes and tools which were difficult to make on the farm.[1] In his study of *minifundios* in Fomeque in the department of Cundinamarca, Haney observed that a large portion of any new income stream was used to purchase goods and services formerly supplied by the farm household.[2]

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[1] James Grunig, *Information, Entrepreneurship and Development*, University of Wisconsin, 1969, unpublished Ph.D. dissertation, Chapter VIII, p. 35.

[2] Emil Haney, *The Economic Reorganization of Minifundio in a Highland Community of Colombia*, University of Wisconsin, 1969, unpublished Ph.D. dissertation, p. 324.

The data employed to test the relationship between the size of the marketed surplus and relative factor proportions on small farms is drawn from a sample of 105 individual farms that were interviewed by Grunig and an assistant.[1] Their interviews were conducted in 1968 in four distinct geographic regions of Colombia: the departments of Valle, Boyaca, Caldas and Meta. There is a well established diversity in the agricultural characteristics of these areas. Small farms in Valle were located in one of the most modern and most soil and climatic rich areas of the country. By way of contrast, Boyaca's small farmers occupied some of the poorest terrain in the country with the majority of farms perched on the steep Andean slopes. Caldas represents a region of predominantly small coffee growers. The small farms in Meta were situated in a frontier region of recent settlement and development usually some distance from major centers of industry and commerce. In view of this substantial geographic heterogeneity in small farm circumstances, farms in each region were treated as samples from separate populations instead of being combined into a single sample unit.

Since changes in the marketed surplus of a given farm in any region will depend on other variables besides alterations in its factor endowment, it is necessary to specify the nature of these other variables and attempt to hold them constant by the use of regression analysis. It is postulated that, in addition to depending on the relative amounts of labor and land, marketed surplus also depends on certain features of the environment which the farmer perceives as barriers to trade and specialization. Among these are the ease of access to transportation facilities for the movement of farm products to consumer markets and the cost and availability of credit to permit storage of crops and to finance consumption and production activities until crop sales are eventually realized. The inability to obtain credit

[1] Grunig, op. cit. The sampling format is explained in Chapter VI and appendix D of Grunig's thesis. I am extremely grateful to Mr. Grunig for making his data available to me and helping me interpret the nature of this information.

could conceivably inhibit market-oriented production responses to new opportunities and increase the risks attached to crop specialization. An additional factor weighing in the decision to produce for outside markets is the degree of competition among middlemen. A concentrated or monopsonistic distribution sector would be anticipated to lower the relative price received by the farmer and thereby discourage his market participation. Also, if farmers confront fixed forward prices they know in advance what price they will receive for their future output and, ceteris paribus, they will be more inclined to produce for the market since a large part of the risk attached to this activity will have been removed. Finally, variation in the relative price of crops, the issue originally investigated by Hymer and Resnick, should influence the size of the marketed surplus although the expected direction of this effect is theoretically indeterminate. Increases in marketed surplus will occur in response to increases in relative crop prices if substitution effects in consumption and production overshadow the income effects of such a price change. It was not possible to obtain a relative price variable from the interview data so gross farm income was adopted as a proxy variable for the missing price information. It should be recognized that gross farm income captures a number of other influences on marketed surplus besides relative price variation, mainly the vagaries of weather and insect or weed damage, the cost of intermediate production inputs, and the probable presence of less risk aversion on the part of larger farmers.[1]

The regression model assumes that a single equation can adequately describe the forces determining the size of the marketed surplus emanating from small farms in each region. While the specification is slightly ad hoc it does at least attempt to control for those variables most likely to influence the dependent variable besides

[1] In the book Public Law 480 and Colombia's Economic Development, Dale Adams, et al., Michigan State University Press, 1964, it is noted that smaller farmers are more likely than larger farmers to sacrifice return for the lower risks of a diversified crop mix. The higher incomes of larger farmers were associated with greater crop specialization and smaller home consumption ratios.

the one whose effect is of major interest. Written in log-linear form the regression equation is expressed as $\ln S_i = K + b_1 \ln Y_i + b_2 \ln OY_i + b_3 \ln C_i + b_4 \ln T_i + b_5 \ln M_i + b_6 \ln(L/A)_i + u_i$ where the following notation is used:

$\ln S_i$ = logarithmic value of sales from the ith farm in any region

$\ln Y_i$ = logarithmic value of gross output produced on the ith farm in any region

K = region specific constant term

$\ln OY_i$ = logarithmic value of the amount of off-farm income earned by members of the ith farm in any region. The function of this variable is explained below.

$\ln C_i$ = logarithmic measure of credit utilized on the ith farm of any region

$\ln T_i$ = logarithmic measure of access to transport services by the ith farm in any region

$\ln M_i$ = logarithmic measure of the distribution channel used by the ith farm of any region

$\ln(L/A)_i$ = logarithmic value of the labor-land ratio on the ith farm of any region

u_i = random error term assumed to be identically and independently distributed with zero mean

Resort to a log-linear form was felt to be desirable for a number of reasons. From the description below of the measures for different variables it is apparent that a nonlinear relationship is likely to exist between a number of independent variables and the dependent variable. From the point of view of theoretical plausibility one might also expect the role played by any one independent variable to be conditioned by the values of other independent variables making a strictly linear relationship an unattractive choice. An added advantage of this procedure is that the regression coefficients in the log-linear formulation can be directly interpreted in terms of elasticities. Moreover, the problem of heteroscedasticity associated with the use of cross-section data may be less severe when the raw variables undergo a log transformation.

Before the expected signs of the regression coefficients can be discussed it is necessary to provide a brief description of the measurements for different variables. The value of sales and gross output were provided directly from the interviews as was the value of income earned off the farm. The latter variable was included to account for any discrepancy between labor residing on different farms and labor available for use on these farms. Since off-farm wage rates were unknown the ideal adjustment of subtracting off-farm labor from total labor supply to derive the amount of on-farm labor could not be applied. As the amount of off-farm income per member of the family labor force increased, the decline in the stock of labor available for on-farm use would, according to the factor proportions hypothesis, raise the volume of marketed output. Two alternative measures of the stock of farm labor, both closely related to family labor size, were used. It is the stock of family labor which may be used in crop production, either on or off the farm, or in Z-goods production that is relevant to the basic hypothesis and not the flow of labor used in any particular activity. The first alternative is the amount of family labor which reflects, in the main, the number of children in the family. However, women were excluded while children were included only if they could perform a man's work. In Grunig's study this stock of family workers per household was converted into a flow by assuming a standard workload of six man-days per week and it is the stock-cum-flow figures which are used here.

The other alternative is the total amount of labor used on a farm where hired and on-farm labor have been aggregated. At first glance it appears that this measure may be less appropriate than the first since it does not strictly refer to the labor endowment of small farms. A moment's reflection, however, raises some doubt about the accuracy of this last judgment. First of all, payments to hired labor may be made in kind and not all hired labor may be engaged directly in crop production. Some hired labor may be employed to repair farm infrastructure for example. More importantly,

a great deal of hiring may involve the use of extended family labor whereby relatives who need work are briefly taken on or may simply be the result of work-sharing agreements among neighbors. In either case the labor endowment would be more adequately described by total rather than family labor use.

Other variables in the regression equation are defined in terms of discrete categories and it is this all-or-nothing measurement basis that is likely to generate nonlinear relationships with the dependent variable. Access to transport facilities was measured in one of two ways, designated T_1 and T_2. The variable T_1 takes on values of 1, 2, 3 or 4 depending on whether the mode of transport was by foot, horseback or canoe, or by horsecart or trailer, or by bus or jeep, or by truck. The alternative measure T_2 was assigned a value of 1 if there was no road near the farm, 2 if there was a road passable by jeep only and 3 if the road could be negotiated by truck. Two alternative measures of credit use, C_1 and C_2 were also available. The first alternative simply indicates the peso amount of credit used per hectare while the second is related to the difficulty of obtaining credit. This last variable is coded 1, 2 or 3 according to whether the farmer stated he experienced no, limited, or strong obstacles in gaining access to sources of credit. The kind of market in which the farmer sold his output and the nature of the buyer is the last variable to be considered. Values of 1, 2, 3, 4 and 5 were assigned to farms according to whether they sold to buyers or a plaza in a village or on the farm, or to a purchaser or plaza in a larger city, or to a cooperative or processor, or to a processor for a stable price, or finally to anyone under a contract. In terms of being able to receive the highest price possible for his output and of reducing the variance of expected future prices the various alternatives can be safely ranked from 1 to 5 in increasing order of attractiveness from the viewpoint of the farmer.

From the foregoing discussion the expected signs of the regression coefficients can be established. A priori it is postulated that the independent variables exert the following directional influence on marketed surplus: $b_1 > 0$, $b_2 > 0$, $b_3 > 0$ for C_2, $b_3 < 0$ for C_1, $b_4 > 0$ for both T_1 and T_2, $b_5 > 0$, and $b_6 < 0$. Only one further problem prior to estimation remains to be discussed, the exogeneity of the independent variables. It can be reasonably argued that off-farm wage rates and the demand for labor, the cost and availability of farm credit, and the type of transport and marketing service used by the farmer are but little affected by the farmer's decision of what fraction of his output he should sell. It may also be presumed that, at least in Colombia where land purchases are difficult for small farmers, the factor endowment ratio is not sensitive to the farmer's marketing decision. However, less confidence can be placed in the exogeneity of the output variable. To some extent this variable reflects the exogenous influence of the fixed prices for outputs and inputs which confront the small farmer, but in large degree it is affected by the size of a farm and the amount of nonland resources commanded by the farm. At best this variable is only partially exogenous. With this caveat in mind, the log-linear regression equation that has been under discussion was estimated using the simple technique of Ordinary Least Squares. The regression results are reported in Tables 1a and 1b where the effects of using alternative measures of the different variables can be clearly seen.

The output variable is highly significant and indicates the elasticity of farm sales with respect to farm output is slightly greater than one.[1] Increase in income

[1]The elasticity is significantly larger than one. If the regression coefficient is constrained to unity and ln (S/Y) becomes the dependent variable there is a substantial increase in the residual sum of squares. An F-test comparing the original and constrained residual sum of squares conclusively refutes the hypothesis of unitary elasticity.

TABLE 1a: Regression Results for Small Farm Marketed Surplus

	K	ln Y	$\ln(L/A)_1$	$\ln(L/A)_2$	lnOY	$\ln T_1$	$\ln T_2$	ln M	ln C_1	ln C_2	$\bar{R}^2$	D.W.
A. Valle												
No.: (1)	4.09	1.12*	-.13**		-.04	-.12		.19*	.18		.90	1.90
		(14.31)	(-1.74)		(-1.17)	(-.64)		(2.64)	(1.01)			
(2)	3.98	1.09*		-.07	-.03	-.10		.17**	.18		.90	1.92
		(14.54)		(-1.11)	(-1.02)	(-.58)		(2.37)	(1.02)			
(3)	4.51	1.06*	-.12***		-.04***	-.06		.13**		.05	.90	1.95
		(11.94)	(-1.57)		(-1.35)	(-.38)		(1.76)		(.64)		
(4)	4.33	1.05*		-.05	-.03	-.05		.12***		.04	.90	1.96
		(11.71)		(-.77)	(-1.18)	(-.31)		(1.61)		(.55)		
B. Boyaca												
No.: (1)	3.65	1.22*	-.22**		.013	.06		-.17	-.23		.94	1.76
		(11.98)	(-1.76)		(.28)	(.61)		(-.66)	(-.92)			
(2)	3.74	1.18*		-.17**	.018	.04		-.15	-.18		.93	1.70
		(12.47)		(-1.72)	(.19)	(.42)		(-.59)	(-.67)			
(3)	3.83	1.21*	-.24**		.01	.05		-.15		.02	.93	1.68
		(10.65)	(-1.79)		(.23)	(.45)		(-.56)		(.37)		
(4)	3.85	1.17*		-.19**	.01	.04		-.13		.01	.93	1.63
		(11.07)		(-1.90)	(.16)	(.33)		(-.47)		(.16)		
(5)	4.03	1.19*	-.22**		.01		.13	-.02	-.21		.93	1.81
		(11.30)	(-1.74)		(.28)		(.64)	(-.73)	(-.83)			
(6)	4.00	1.16*		-.18**	.01		.07	-.17	-.16		.93	1.74
		(11.67)		(-1.78)	(.20)		(.36)	(-.64)	(-.60)			

TABLE 1b: Regression Results for Small Farm Marketed Surplus

	K	ln Y	$\ln(L/A)_1$	$\ln(L/A)_2$	lnOY	$\ln T_1$	$\ln T_2$	ln M	ln C_1	ln C_2	$\bar{R}^2$	D.W.
C. Caldas												
No.: (1)	4.28	1.09*	-.14*		-.002	-.008		.007	.13*		.99	2.35
		(35.87)	(-2.86)		(-.12)	(-.22)		(.40)	(6.44)			
(2)	4.20	1.07*		-.09**	-.02	-.007		.009	.12*		.99	2.35
		(46.14)		(-1.89)	(-.97)	(-.23)		(.52)	(6.54)			
(3)	4.41	1.06*	-.12**		-.002	-.01		.005		.08	.99	2.26
		(28.89)	(-2.38)		(-.08)	(-.35)		(.31)		(.80)		
(4)	4.24	1.07*		-.09***	-.016	-.008		.008		-.001	.99	2.19
		(32.31)		(-1.56)	(-.87)	(-.22)		(.44)		(-.05)		
(5)	4.30	1.09*	-.13*		-.004		.023	.01	.13*		.99	2.46
		(35.48)	(2.83)		(-.22)		(.65)	(.53)	(6.01)			
(6)	4.21	1.07*		-.09**	-.017		.003	.01	.12*		.99	2.41
		(43.85)		(-1.86)	(-.98)		(.10)	(.53)	(6.35)			
D. Meta												
No.: (1)	3.05	1.10*	.05		.005	.12*		.023***	.17*		.98	2.71
		(15.76)	(1.39)		(.32)	(6.49)		(1.65)	(3.08)			
(2)	3.07	1.12*		-.01	.01	.11*		.017	.21*		.98	2.66
		(18.20)		(-.67)	(.60)	(5.97)		(1.22)	(3.62)			
(3)	2.80	1.12*	.12		.01	.12*		.018***		-.09*	.98	2.79
		(16.45)	(1.33)		(.73)	(6.89)		(1.43)		(-2.80)		
(4)	2.91	1.15*		.02	.017	.11*		.013		-.07**	.98	2.72
		(17.56)		(1.11)	(1.03)	(6.08)		(.98)		(-2.04)		
(5)	3.25	1.16*	-.09**		.03		-.22*	.04*	.17**		.97	2.48
		(13.72)	(-2.09)		(1.32)		(-6.72)	(2.54)	(2.39)			
(6)	3.23	1.16*		-.09*	.03		-.23*	.03**	.17**		.97	2.50
		(15.94)		(4.02)	(1.49)		(-7.47)	(1.81)	(2.45)			

Notes: (1) There were 30 observations for Valle and 25 each for the other regions.
(2) $\bar{R}^2$ is R^2 adjusted for degrees of freedom and D.W. is the Durbin-Watson statistic.
(3) t-values are given in brackets beneath the regression coefficients.
(4) $(L/A)_1$ and $(L/A)_2$ refer to total and family labor use per hectare respectively.
(5) Single, double and triple asterisks denote significance at the 1, 5 and 10 percent level respectively.
(6) A complete lack of variance for the variable T_2 in Valle resulted in two fewer regressions for Valle than for the other areas.

or output are likely to lead to proportionately larger increases in farm sales. To the extent higher incomes are associated with larger farm size, this result can be explained by invoking greater specialization and less risk aversion on the part of larger farmers. With one exception, Meta, the factor endowment variable performs in the way it was hypothesized to work. Higher amounts of labor per unit of land are, ceteris paribus, negatively related to the value of marketed surplus. The strength of this relationship is more apparent when total rather than family labor per unit land area is used. Failure to discern the same relationship for Meta could stem from the fact that in this region, unlike the others land is relatively abundant with respect to the supply of labor.[1] However, even Meta conforms extremely well to the hypothesis if T_2 instead of T_1 serves as the independent variable for transportation service. Exactly why this should occur is something of a mystery.

The other variables are not consistently significant across the various regions Off-farm income shows up as barely significant in only one of the equations for Valle where it has a negative sign. If off-farm workers spend most of their time away from their own farms in Valle they may grow crops almost exclusively for own-consumption and perhaps it is this behavior pattern which is most prevalent in the department of Valle. When T_1 is used as the transport variable it is significant with the expected sign only in Meta, the area in which means to move farm products to urban markets are most underdeveloped and deficient. With improved transport facilities the results suggest more output would be forthcoming from the Meta region. Substitution of T_2 for T_1 occasions a sign reversal for the transport variable in Meta which is as difficult to explain as the sign reversal for the factor endowment

[1] Because soils in Meta are reputed to be substandard this relative abundance may be smaller than it appears if quality corrections could be made.

variable. Instability in this case may be simply a reflection of the crudeness of measurement for the transport variable. Closely related to transport mode is the market channel used to dispose of surplus farm production. Inasmuch as markets outside local villages are often beyond reach due to high transport costs, T and M involve the same considerations. The choice of marketing channel is invariably significant in Valle but insignificant elsewhere. In Valle a number of producers were selling to processors at fixed forward prices and this kind of contractual price certainty may account for the results in that area. Finally, contrary to expectation, the variable for credit C_1 appears as significantly positive in Caldas and Meta but insignificant from zero in other areas. It could be that farmers in Caldas and Meta who had trouble obtaining credit were forced to sell a larger fraction of their output in order to pay their bills. Under these circumstances an increase in the supply of credit would lead to a reduction in the amount of marketed surplus. The alternative for C_1, C_2, can be given an identical interpretation for Meta but does not do well in other regions.

Overall, the regression results are mildly encouraging. Although the size of farm output explains most of the variation in marketed surplus, there is some statistical support for the notion that marketed surplus is inversely related to the labor-land ratio on small farms. Given the imprecision with which most of the other independent variables are measured not much can be said about their role in determining the size of marketed surplus. This imprecision no doubt contributes to their general lack of significance. When they are consistent, however, these variables do not have signs which violate a priori beliefs about the manner in which they operate.

4. Conclusions

This paper has extended a theoretical model of Z goods production to generate a hypothesis about how changes in the factor endowment of small farms impinge on the decision of small farmers to sell or consume their output. Higher degrees of small farm labor intensity shift the comparative advantage of production towards greater Z and less crop production. If tastes of small farmers meet some additional (non-stringent) requirements, that all goods are normal and that Z and crop goods are complements in consumptions while Z and nonagricultural goods are substitutes, it can be rigorously demonstrated that higher labor-land ratios will be associated with lower amounts of marketed surplus. Using data derived from a sample of small farms in Colombia it has been possible to subject this factor intensity hypothesis to statistical testing. The empirical results, while hardly spectacular, tend to be consistent with the hypothesis about small farm factor proportions. However, due to the difficulty of measuring Z goods production directly the empirical results do not rule out the possibility that some alternative mechanism is at work and is responsible for the observed inverse relationship between farm sales and labor-land ratios. Regardless of whether the Z goods or another model is in operation, the empirical results have an interesting implication for economic development. These results suggest that increases in the nonagricultural demand for labor which are satisfied by small farm workers will also elicit an increased supply of crop goods from small farms. For this reason the increase in labor demand will have a smaller tendency to be choked off by changes in the terms of trade that are unfavorable to the nonagricultural sectors of the economy.

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