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MICRODYNAMICS OF CONTRACTION DECISIONS: A COGNITIVE APPROACH TO STRUCTURAL CHANGE

by

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> The farm problem...is primarily a problem of economic growth. The demand for farm products grows more slowly than the demand for nonfarm products; consequently economic growth requires a steady shift of labor and other resources from agriculture to other sectors. Since there is resistance to this shift, there are usually too many people in farming and as a result per capita farm income is depressed (Houthakker, p. 5).

Structural change in U.S. agriculture, incorrectly dubbed a "revolutionary" change in the farm sector, continues to result in fewer but larger farms producing most of the country's marketed food supply. During the "unprecedented export boom" period of the 1970s (Schuh), explanations of concentration in food production focused on factors such as inflated land values and farm equipment which made it difficult for the beginning farmer to get started (USDA), inflationary increases in production costs and indebtedness, and the inexorable investment demands of rapid technological change (Cochrane). Given the reversal of that boom in the 1980s (Schuh), and the accompanying decrease in farm incomes, increase in cash-flow problems, and decline in land values, explanations of structural change now center on the indirect impact of fiscal-monetary policies (Tweeten,1983), and the "internationalization of capital" and high instability in world demand (deJanvry,1982).

Although the current failure of exports to solve the chronic oversupply problem in U.S. agriculture has undoubtedly intensified the farm income crisis, Schultz and Houthakker remind us that economic growth, the tendency of people to spend a

smaller proportion of their incomes on food as incomes rise, and inelastic demand coupled with supply shifts due to technological change have been causes of "the farm problem" in U.S. agriculture for decades. Houthakker also notes that "what makes the farmer...give up farming is not Engel's law.... The individual farmer is in no position to detect the basic laws that force him out of farming" (pp.8-9).

How then does the farmer perceive and react to the current farm crisis? What are the microdynamics of structural change as perceived by farmers themselves? Given world market instability, farmers'expanded debt commitments, depressed farm prices and deflated land values, how do farmers adjust? Do they now perceive themselves to be pushed or pulled out of farming?

This research attempts to answer these questions, via an analysis of detailed farm history and decision data from a set of farmers in Gadsden County, North Florida, which lost its major money crop, shade tobacco, during the mid 70s due to changes in international markets coupled with technological change. The events that followed, and the farmers' decision processes in reaction to those changes, are described here in the belief that these reactions may be shared by other farmers in a crisis. As will be seen, results show that events in Gadsden forced some full-time farmers to go out of business entirely and others to cut back production substantially. As a result, the farmers who remained in business either were or became larger operators, or they gradually got transformed into part-time farmers. To survive in Gadsden, a farmer had to get large, get out, or get off-farm work.

Since 1935, Gadsden County has exhibited the usual symptoms of concentration. These include: a declining number of farms and increasing average size of farm, a decreasing amount of land in farms and harvested cropland and an increasing proportion of part-owners of farmland, and a highly-skewed distribution of land in farms and gross sales (Zabawa, 1984). The uniqueness of Gadsden was due to the presence, since 1890, of shade -- or cigar-wrapper -- tobacco, which accounted for 65 percent of the value of all agricultural products in 1969. During the years 1969-77, however, "shade" as a money crop disappeared due to increasing costs of production, competition from Central America, and the decline in demand for cigars. In addition, the development of a synthetic "homogenized" wrapper for cigars and the use of a plastic tip meant that a full leaf was no longer necessary to bind the cigar together. With the market decline of shade, farmers accustomed to forward contracts with tobacco companies had to look for new cropping strategies and in some cases completely new ways of making a living.

Individual Farmers' Responses to the Loss of Shade

The decision processes used by individual farmers in their search for new ways to make a living are modeled via decision tree models which assume that at some time(s) during the farm's history, the farm family makes sequential decisions of whether or not to cut back production (fig. 1) and what method to use to cut back (fig. 2). Interrelated logically with these decisions are subdecisions, for brevity presented elsewhere, which include the change of crop decision (Gladwin, Zabawa, and Zimet), the decision to sell land, and the decision to lease out land

(Zabawa). The decision to quit farming is not a separate subdecision, but a result of the farm family's decision to sell most or all of their land.

The different options in each decision are seen in the set of alternatives (denoted by { }) at the top of each decision "tree" model, which deterministically processes the information considered by each individual farm family. The host of factors that enter into an individual's decision process are called "decision criteria" or aspects or constraints and can be read in the diamonds (denoted by < >) at the "nodes" or branching points of the tree (Gladwin). They are either goals motivating the decision, aspects to be "maximized" or ordered on, or constraints that must be satisfied by the individual on the way to a particular outcome or choice (denoted by ▭). The model is hierarchical rather than linear additive because it is assumed decision makers compare alternatives on selected aspects (one dimension at a time) and then subject them to often-qualitative constraints, rather than holistically compare alternatives based on assigned weights or utilities.

The decision model is specified after personal interviews with a representative sample of farm families; it is then tested against actual choice data collected from a second, independent sample of decision makers. The use of elicitation procedures to generate the specific decision criteria (and their logical order in the tree) also distinquish decision tree models from more conventional decision models used in economic analysis. In a linear programming model, for example, the objective function and

constraints are usually assumed to be correctly specified but are in fact untested against choice data collected from a sample of decision makers. In Gadsden County, data from 30 farmers were used to build the model in 1982; while data from 72 farmers (51 ex-shade producers and 21 non-shade producers) were used to test the model in 1982-83. The samples were judged representative because the distribution of farms in the samples matched the distribution in the county by farmland acreage and gross sales based on agricultural census data.

The model in fig. 1 posits that the Gadsden County farmer, faced with the decision of whether or not to cut back production, must have at least one of the reasons to cut back which are specified in the decision criteria. These include: the sudden appearance of a buyer with an offer too good to refuse (criterion 1); a reason for not being able to farm all of one's land on one's own, e.g., bad health or old age or off-farm work (criterion 2); an inability to make money farming or subsidize the farm with off-farm income (criterion 3); a reason and ability to change the cropping strategy (criteria 4,5); a large debt to asset ratio and negative feedback from a lender (criteria 7,9,10,11,12); and the decision by one or more family members to increase their off-farm work involvement (criterion 8).

Given a farmer's presence at any "Cut back" command, he or she (i.e., his or her data) may proceed to the decision model of <u>how</u> to cut back (fig. 2). Alternative methods, ranked by the degree to which the farmer relinquishes control over the land, include: hire a manager, get a partner, cut back land usually rented in, lease (out) land, or sell land. After elimination of

the first three easy ways to cut back, a farmer decides whether to sell or lease (out) land. Reasons to sell rather than lease include an inability to pay the mortgage from farm income (criterion 4), an immediate need for a sizeable amount of capital (criterion 5), and/or a need for a change in lifestyle (criterion 6). Given any of the above reasons, farmers sell land if they consider the reasons to sell more important than the reasons to lease, and they pass constraints including clear title to land, presence of an interested buyer, and a good price offer. Failing one constraint, farmers pass to the subdecision to lease, which includes criteria such as presence of a renter at a good price, presence of the motivating pull of profit or push of possible loss of the tax exemption, and risk criteria. Farmers' failing to pass criteria in both subdecisions continue to search for a solution and farm the land themselves.

The models were tested on 230 cases of possible cut-backs by 72 farmers, because farmers could decide to cut back more than once in the farm's history. Test cases included every time farmers actually cut back production or land use or reported that they thought about cutting back. The results are shown, for brevity, on the trees themselves; the model, including all subdecisions, correctly describes 95% of the choices made. Two of the results are noteworthy. First, due to the hierarchical nature of the model, cases in which farmers cut back due to low farm incomes could be separated from cases in which other factors such as old age or bad health were important. Results in fig. 1 show that 30.4% of the cases were cut-back decisions because

farmers could no longer farm all their land themselves, due to time demands of off-farm work, old age, or bad health; or they had received a great offer from a buyer (criteria 1,2). In more than half the cases (55%), however, farmers were no longer making money farming. To remedy this situation, farmers in 37.8% of the cases had to cut back as a result of change of crops or lender, or an increase in off-farm work. In another 31.8% of the cases, farmers chose not to cut back. Of those who did, however, more farmers were pushed out of farming by low farm incomes than by other conditions.

Results also show that shade and non-shade producers take different paths in figures 1 and 2 to cut back production and/or land use. Two-thirds of the shade tobacco cases which reach the hard decision to sell vs. lease land in fig. 2 are sent to the decision to sell rather than lease land. On the other hand, all of the non-shade cases which reach this decision point are sent to the subdecision to lease rather than sell. In 56 (31%) of the shade cases, as compared to four (8%) of the non-shade cases, is land actually sold. (Fourteen shade and four non-shade cases do not appear on fig. 2 because they were sent directly to the subdecision to sell by criteria 1 and 9 in fig. 1).

Transformations of Shade Producers

Why do shade and non-shade producers take different paths to cut back production? In general, these differences reflect differential access to resources in the 1970s, before the collapse of the market for shade tobacco. By that time, shade producers had accumulated more land (459.3 acres on average) to sell than non-shade producers (176.8 acres, $p=0.001$). Not only

had more of them inherited land initially, and more of it; but they had also expanded more via land purchases and rentals than non-shade producers had, while the market for shade was good. When expanding, shade producers tended to buy land rather than rent it (χ^2=4.24,p=0.025).

The second reason for the use of different cut-back strategies is that traditionally, non-shade producers had more off-farm income than shade producers and thus less pressure to sell land. Although the majority of non-shade producers were full-time farmers by our definition in Table 1, 52% also had full-time off-farm work and 82% of the active farmers had some off-farm income supplied by either the farm head or spouse. (Because we define a full-time farmer to be an operator -- of either sex -- who farms at least 40 hours per week, it is possible for a full-time farmer to also have full-time off-farm work.) In contrast, only 8% of the full-time shade producers also had full-time off-farm work in the mid 70s, and only 37% had some off-farm income supplied by either the farm head or spouse. Because shade producers had less experience in the off-farm labor market -- a valuable resource -- they had more incentive to sell the land they had accumulated.

The main reason for differences in cut-back strategies of shade and non-shade producers, however, is that the shade producers -- all full-time farmers -- underwent a further differentiation process (deJanvry, 1981:pp.117-140) in the process of searching for a substitute money crop after the demise of shade tobacco. Results of testing the change of crops

subdecision, described elsewhere (Gladwin et al.), show that some ex-shade producers wanted to stay full-time and so switched to nursery crops or staked tomatoes, the crop most similar to shade tobacco in use of managerial style and resources such as land, labor, equipment, and capital. Due to the high capital requirements and volatility of the market for tomatoes, however, only a fraction of them survived as full-time farmers through 1982. Those who did survive were on a larger scale, as measured by gross sales and assets in Table 1. Other shade producers switched to pole beans and squash, hogs, row crops (soybeans, corn, grain sorghum, peanuts,etc.), and beef cattle on a part-time basis; while some quit farming. As a result of this transformation, 19 of the 51 shade producers became larger full-time farmers; 11 became smaller part-time farmers; 9 quit farming altogether and 12 retired from farming (χ^2=44.96,p=0.001). Tests of the differences between subgroup means in the mid 70s show that: (1) farmers who remained full-time were younger than the part-timers and retired farmers; (2) farmers who quit farming had less wealth (assets, owned acreage) than the full-timers but no differences in age, education, or debts; and (3) part-timers had no less assets but were older than the full-timers and had smaller debts and debt to asset ratios. Clearly, the older farmers who became part-timers were not used (or willing) to incur the heavy debt load of the full-timers with similar assets.

Results in Table 1 show that the differences between the subgroups of ex-shade producers, as well as those between shade and non-shade producers, became magnified over time, as expected. Gross sales, net farm income, and assets of the full-time ex-

shade producers were significantly greater in 1982; whereas assets of the part-timers, non-farmers, and retired farmers did not change. Debt and debt to asset ratios of the full-timers, however, also increased significantly; whereas debts of the part-timers and retired farmers did not change and those of the non-farmers decreased significantly. These results suggest that part-time farmers' conservative credit policies were allowing them to hold onto their assets. Although full-time farmers are now larger, their debt to asset ratios as well as assets have doubled in approximately seven years!

Conclusion

Results of analysis of farm history data of ex-shade producers after the collapse of the local market for shade tobacco show that full-time farmers underwent a differentiation process whereby a minority of the farmers remained full-time on a larger scale than before, while the majority became either part-time farmers or non-farmers. Our results thus agree with the underdevelopment theorists who argue that technological change and economic growth forces the individual profit-maximizing farmer to either get large, get out of farming, or get off-farm work (deJanvry). This differentiation process, viewed in the aggregate and over time, is structural change. Rather than focus structure debates on whether small farms are more beautiful, satisfying, and soil- and energy-efficient than larger farms (Tweeten,1983), our results suggest that structure debates should be centered on alternative explanations of the transformation of the medium-sized full-time farmer into a small, part-time farmer.

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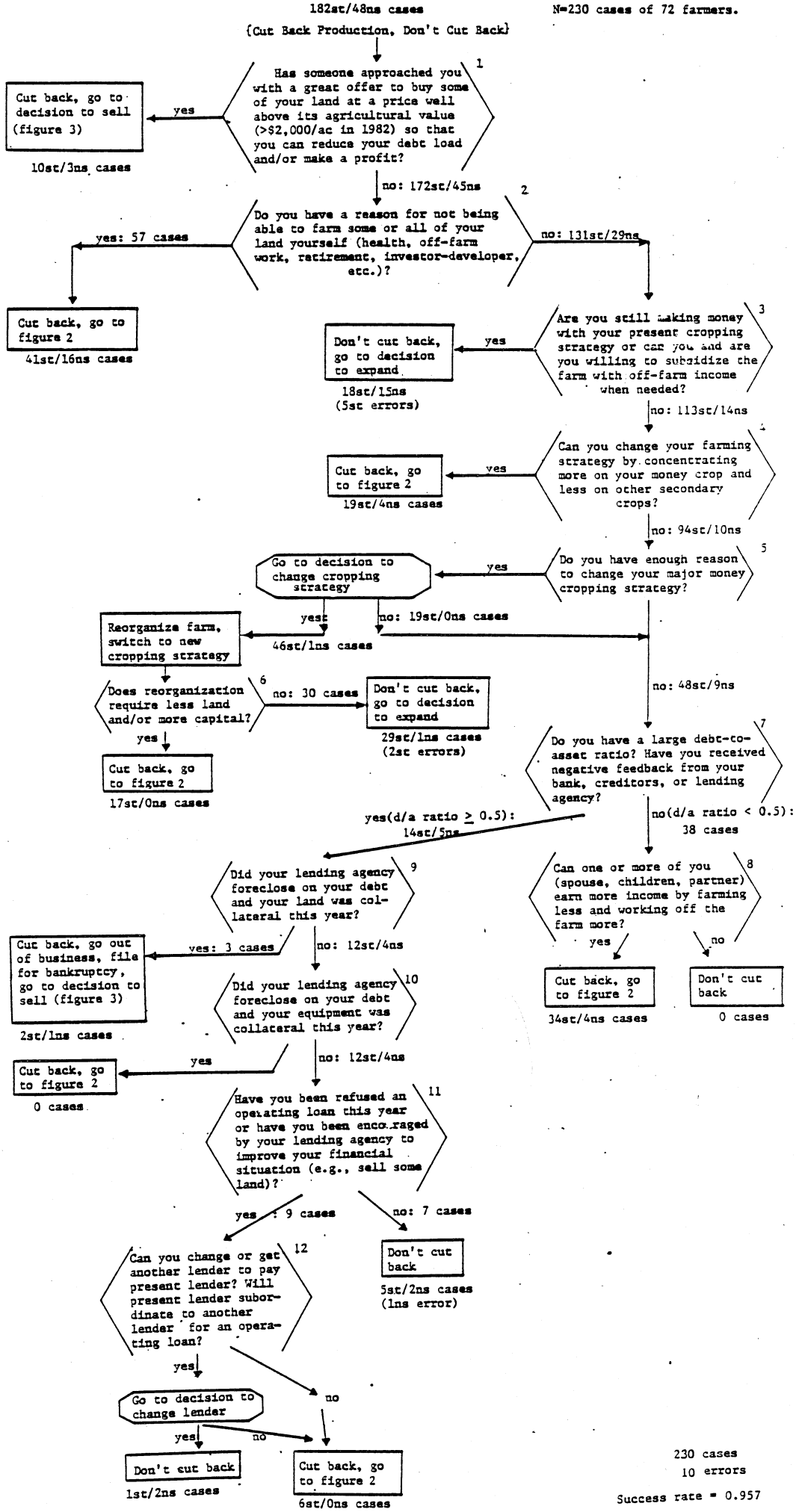
Figure 1: The Decision to Cut Back Production.

N=230 cases of 72 farmers.



230 cases
10 errors

Success rate = 0.957

Figure 2 : The Decision How to Cut Back.

N=141 cases of 55 farmers

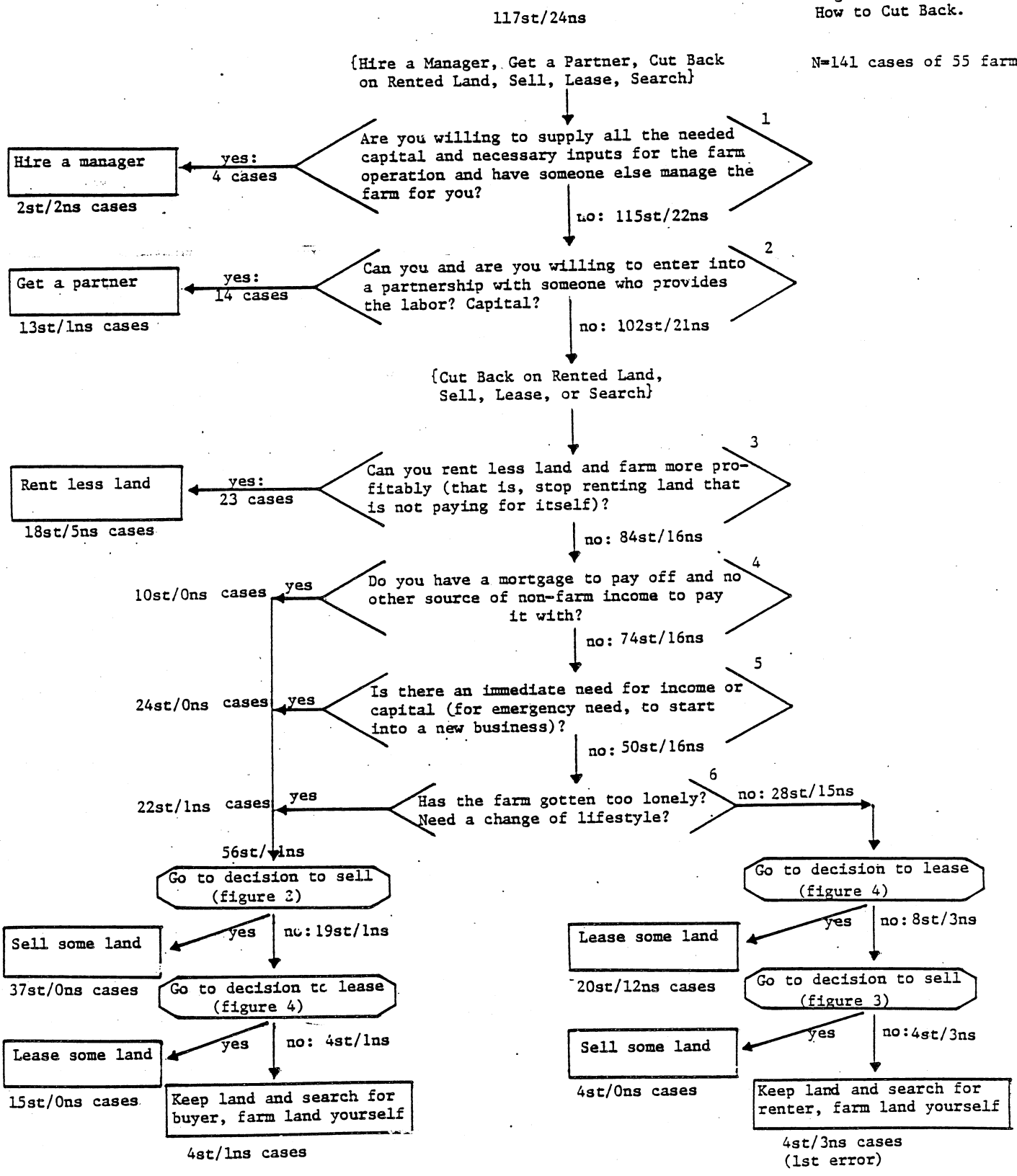


Figure 3 : The Decision to Sell Land.

N=84 cases of 39 farmers

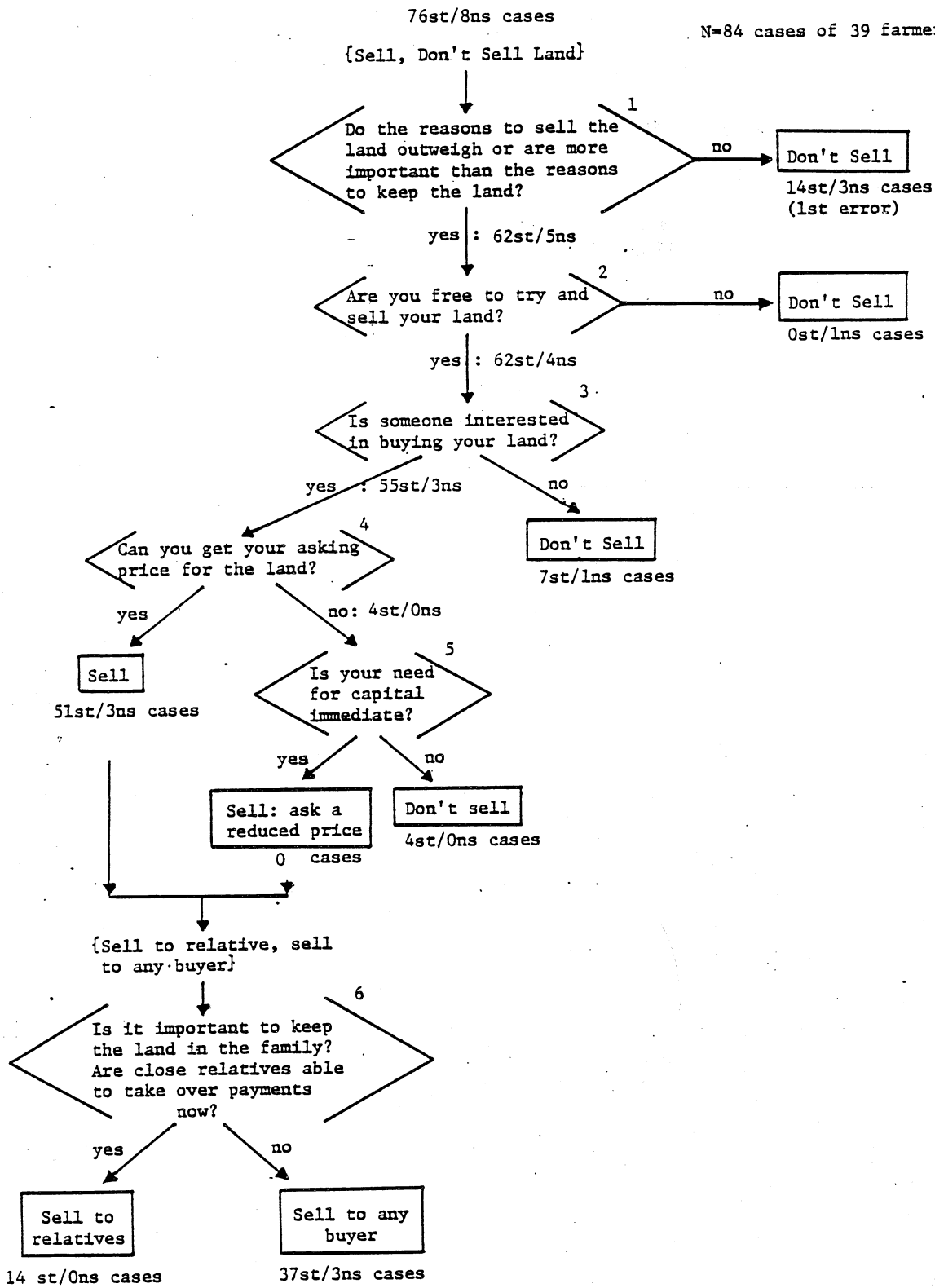


Figure 4 : The Decision to Lease Land.

N=63 cases of 41 farmers

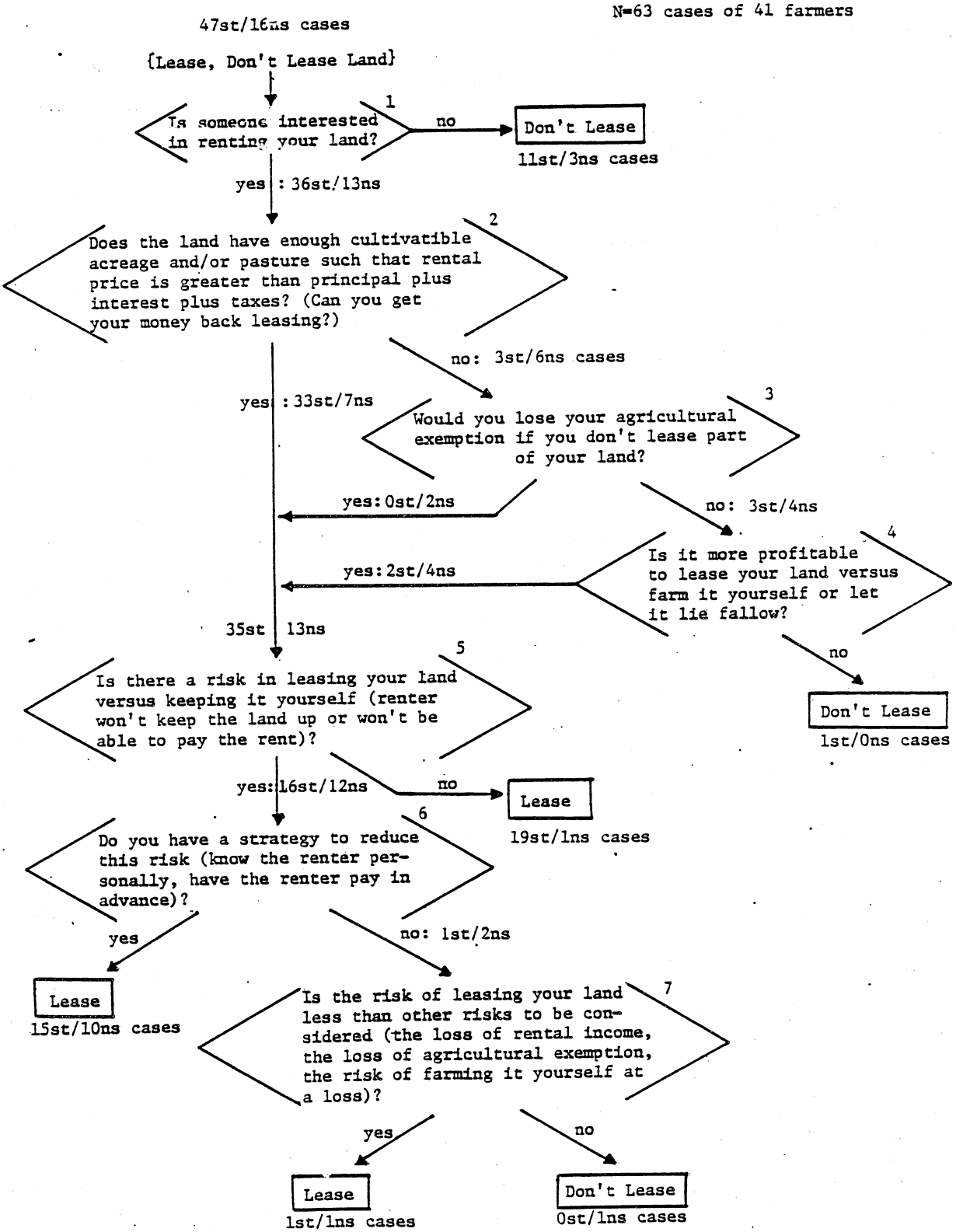


Table 1. The Transformation of Full-Time Shade Farmers to Full-Time, Part-Time, Non-Farm, and Retired Farmers.

SHADE SAMPLE (N=51 Full-Timers in last year of shade)	Full-Time[a] in 1982 (N=19)	Part-Time in 1982 (N=11)	Non-Farmer in 1982 (N=9)	Retired in 1982 (N=12)
Gross Sales in last year of shade ($)	110,868	105,818	89,375	73,667
Gross Sales in 1982	295,469	31,404	1,130	1,395
T-Value[b]	(2.35)**	(-2.88)***	(-5.39)***	(-2.65)***
Net Farm Income in last year of shade ($)	-10,342	14,000	0	9,167
Net Farm Income in 1982 ($)	71,574	2,676	1,064	658
T-Value	(2.56)***	(-2.01)**	(0.10)	(-1.21)
Debts in last year of shade ($)	61,741	10,909	48,333	28,583
Debts in 1982	182,921	12,273	10,000	22,917
T-Value	(1.77)**	(0.62)	(-1.63)*	(-0.27)
Assets in last year of shade ($)	385,169	387,727	166,263	182,687
Assets in 1982	681,781	516,727	99,000	146,713
T-Value	(1.63)*	(0.46)	(-0.91)	(-0.66)
Debt-to-Asset ratio in last year of shade (%)	17.9	5.2	31.9	15.0
Debt-to-Asset ratio in 1982	33.6	4.5	3.5	7.2
T-Value	(1.59)*	(-0.14)	(-1.92)**	(-0.76)
Owned Acreage in last year of shade (ac)	509.7	442.1	172.7	267.0
Owned Acreage in 1982	436.7	480.5	81.9	164.9
T-Value	(-0.43)	(0.13)	(-1.37)*	(-1.63)*

NON-SHADE SAMPLE in 1982 (N=21)	Full-Time (N=13)	Part-Time (N=4)	Non-Farmer (N=4)	Retired (N=0)
Gross Sales ($)	94,667	7,688	1,073	-
T-Value[c]	(-2.39)**	(-2.15)**	(-0.07)	
Net Farm Income ($)	18,000	813	1,072	-
T-Value	(-1.75)**	(-0.53)	(0.01)	
Debts ($)	73,455	47,567	9,813	-
T-Value	(-1.48)*	(1.46)*	(-0.02)	
Assets ($)	251,091	177,500	93,750	-
T-Value	(-2.06)**	(-1.28)	(-0.06)	
Debt-to-Asset ratio (%)	33.7	20.0	13.8	-
T-Value	(0)	(1.89)*	(0.83)	
Owned Acreage (ac)	177.0	113.5	115.0	-
T-Value	(-1.94)**	(-1.42)*	(0.36)	

Notes: [a]We define a full-time farmer to be one who farms at least 40 hours per week year-round, a part-time farmer to be one who farms between 8 and 40 hours per week year-round, and a non-farmer to be one who farms less than 8 hours per week year-round.

[b]T-value tests difference between means of two previous rows. Significance levels of the one-sided T-Test are:

*>0.05 and ≤ 0.10 **≤ 0.05 ***≤ 0.01

[c]Statistical comparisons are made between the non-shade sample and the corresponding shade sample for 1982.