TOBACCO MECHANIZATION AND POTENTIAL OUT-MIGRATION*

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This paper reports an investigation of the potential out-migration response to flue-cured tobacco harvest mechanization in an eight county area of eastern North Carolina. The study is unique in that lost harvest earnings and potential out-migration response are reported in a household context. In addition, as the adoption process of mechanization is still in its beginning stages, out-migration responses are those that could be anticipated.

The impact of increased agricultural productivity and substitution of capital for labor are familiar to agricultural economists. So, too, is the social concern about farm-to-city migration which accompanied the mechanization of agriculture. Memory of population adjustments associated with the mechanical cotton picker has caused analysts and policy makers to be sensitive to effects of new developments which might lead to additional rounds of migration. With cotton, for example, the 61 counties and parishes of the Delta had a 75 percent reduction in farms in 20 years [10]. In Mississippi, there was a 50 percent decline in rural farm population in just 10 years [3].

Adoption of bulk curing and development of mechanical tobacco harvesting in the early 1970s brought new concerns that large numbers of farm workers in the southeast might be adversely affected. Lost harvest employment would reduce the incomes of a large number of workers and conceivably could unleash a substantial migratory flow. This in turn could adversely affect both rural and urban areas, generally depressing areas losing population and congesting those gaining it.

Before presenting our projections of potential out-migration, models used to project the rate and extent of harvest mechanization, characteristics of the current work force, and predicted characteristics of workers losing employment and the households in which they reside are briefly presented. In the final section, considerations for a more complex model of migration projections are specified.

STUDY APPROACH

Confronted with the prospect of rapid mechanization of the tobacco harvest and the dearth of data on tobacco harvest workers and producers, a study examining the importance of tobacco to workers and producers was developed by North Carolina State University (NCSU). This study used the USDA-Economic Research Service studies identifying initial labor utilization and estimating the aggregate reduction in hours of harvest labor based on a linear programming analysis of 1972 tobacco farm survey data [4, 5].

Initial hours worked per task, age-sex specific distribution of workers by task on tobacco farms [4] and the LP models' changes in task hours [5] enabled the development of coefficients on changes in hours worked by sex. These represent the demand change in hours based on harvest task. In addition, a reduction in farm numbers was projected to occur because of mechanization.

To simulate the release of workers from harvest, a hierarchy reflecting relative distribution of work done for those tasks most and least affected by the mechanization process was established. In general,

there would be a relative shift in tasks during mechanization from those requiring more manual dexterity to those requiring more physical strength. The youngest and oldest workers were therefore released first. Those last to be affected would be prime age workers, 25-44 [6].

In the NCSU study, a random sample of labor force households in a tobacco producing region of North Carolina were surveyed to estimate the supply of labor to tobacco production and harvest.[1] In this case, it was possible to identify hours worked by specific age-sex classes. The specific changes in hours developed from the demand side (ERS study) were applied to the initial supply of hours worked (NCSU study), according to the hierarchy established to estimate decrease in workers. Changing structural requirements and consolidation of farm units dictated by the LP models were adapted to the NCSU supply data by requiring farm producers to consolidate on the basis of family hours worked in tobacco harvest relative to all work on their own farm and farm tenure. Assumptions and methodology associated with the various models are developed in [6]. In general, however, whenever two or more alternative assumptions or models could be used equally as an analog of adjustment, the one likely to represent the more severe adjustment was selected. In examining a potential adjustment problem, it would be better to err by overstating rather than understating the potential problem.

MECHANIZATION IMPACT

In 1972, about 25 percent of all employed persons in the study area either worked for hire or on the family farm in tobacco harvest. The average harvest work time was 256 hours for hired workers and 458 hours for unpaid family workers. Fifty-one percent of the hired workers and 23 percent of the unpaid family farm workers were less than 18 years old. About 11,100 households had hired harvest workers and 5,300 had unpaid family farm harvest workers, 27 percent of the total work force households.

Harvest labor requirements would be reduced by about 47 percent for hired labor and 44 percent for

family labor with mechanization and with no change in tobacco production (quota) from 1972 levels by 1980. Reduction in labor requirements represented a loss of harvest earnings of about $2.9 million (−45 percent) for hired workers households and $3.5 million (−42 percent) of imputed harvest labor earnings for farm family households. Losses represented about four percent and seven percent, respectively, of household income.[2] Approximately 29 percent of the hired worker households and 32 percent of family farm worker households would no longer have members involved in tobacco harvest at the end of the period.

The impact of mechanization was not confined to those households expected to no longer have tobacco harvest workers by 1980. Other households were also affected by having one worker out of two displaced or by having one worker losing only part of the 1972 harvest work time. These losses were also included above. Prevalance of sources of income other than harvest work is indicated by the difference between the proportion of harvest earnings lost and the loss of household income.

POTENTIAL OUT-MIGRATION

One response to a loss of employment and earnings is to move from the area in search of a new job if one is not available within commuting distance and/or if income promises to increase enough to pay relocation cost. Migration is an investment [9] whereby the present value of moving increases as years of expected employment increase, as employment opportunity rises, as moving costs decrease and as the discount rate for future income decreases. Observable characteristics associated with these factors are age and educational attainment of the household head.

For our purposes, assuming a household's earnings in 1972 were about the same as they would have been in a different location, lost harvest earnings would represent the gross gain from moving to a new area. It was assumed that a $500 or more loss in earnings per household would be necessary to stimulate out-migration and offset the cost of moving.[3]

In addition to the absolute level of lost earnings,

[1]The survey was conducted by the Department of Economics and Business, North Carolina State University, with the assistance of a grant from the U.S. Department of Labor, Employment and Training Administration (TPRM Grant No. 21-37-73-25). There were 1,515 usable questionnaires from labor force households. Data reported in this paper are weighted to reflect the population of labor force households in the area. For details on the area, sample or results cited in this paper, see [6].

[2]Income was defined to include all earnings from work, interest and rents received, transfer payments, retirement benefits, and so forth. Earnings for unpaid family labor were imputed.\Returns to management and capital (except for rents) were not available for self-employed persons, including farm operators.

[3]In a study of eastern Kentucky households migrating between April 1, 1965 and April 1, 1970, family migration cost an average of $378 [7, p. 93]. The study period centered on 1967. The Consumer Price Index for 1972 was 125.3 (1967 = 100) [11, p. 417] so the average migration cost would be $475 in 1972 prices. A study of rural Tennessee families in 1974 determined an average of $750 additional income would be required to migrate to a small nearby urban growth center [8, p. 237]. Part of the additional income required for moving incorporates the costs of migration. The balance is "psychic costs" of migration. We therefore added $25 of "psychic cost" to the physical costs of moving to reach the total of $500 used in the study.

potential migration would also be related to the relative importance of the loss to household gross income. We assume a $500 would be a greater stimulus for a family with gross income of $2,500 than for a household with $10,000. For example, the cost of job search would be greater for the higher income family through income foregone. Therefore, we assume the probability of out-migration increases as the ratio of lost earnings to gross income increases. Other household characteristics likely to affect potential migration would include age of the household head (as age increases, present value of lifetime benefits from migration decreases so potential for migration decreases) and his educational attainment, assuming education is a proxy for skills. All "hypotheses" are based on *ceteris paribus* conditions. Losses of harvest earnings were not necessarily those of the head of the household, however. They could be associated with any household member.

To estimate the migration potential, it was first necessary to identify those households most likely to migrate, given our assumptions. Therefore, we first determined those likely to migrate on the basis of earnings lost (at least $500), the subsequent relative decrease of household income, and age distribution of household heads. Once the group more likely to migrate was identified, selected household characteristics were examined to see if they would tend to support or inhibit potential migration. While a statistical model estimating probable migration would be very useful to analyze these characteristics simultaneously, this study does not develop probability coefficients because migration has not yet occurred. We are not aware of other studies which contain coefficients that could be applied to our data.

Assuming no change in the level of tobacco production between 1972 and 1980, the simulated mechanization process would place about 1,700 hired households and 2,200 own-farm households in potential migrant status. These represented about 15 percent and 40 percent of the households, respectively, exposed to displacement.

Distribution of households losing $500 or more by age of head and percentage of income lost presents the initial impression of migration potential. As one comes down a column of Table 1, potential for out-migration increases or, as one moves from right to left across rows, potential for migration increases. Therefore, out of all potential migrants, those most prone to move would be those cases in which the head of household was less than 35 and lost earnings were 20 percent or more of income. About five percent of both hired and own-farm households were

TABLE 1. TOBACCO HARVEST WORKERS' HOUSEHOLDS VULNERABILITY TO MIGRATION FROM MECHANIZATION AND LOST HARVEST EARNINGS: BY AGE OF HEAD AND TENURE OF HOUSEHOLD[a]

	Age of Head					
Gross income lost	Less than 35	35-44	45-54	55-64	65 or over	All families
	Percent					
Hired households[b]						
Less than 10 percent[c]	1.9	6.5	12.3	4.5	--	25.2
10-19 percent[c]	5.5	--[e]	14.2	2.1	6.3	28.1
20 percent or more[c]	4.5	11.7	19.8	4.2	6.5	46.8
Total	12.0	18.2	46.3	10.8	12.8	100.0[f]
Own farm households[d]						
Less than 10 percent[c]	3.3	--	6.5	--	--	9.8
10-19 percent[c]	3.4	5.0	22.2	7.9	6.0	44.5
20 percent or more[c]	5.6	14.3	9.8	8.8	7.0	45.7
Total	12.3	19.4	38.6	16.7	13.0	100.0[f]

[a]Households losing at least $500 from simulated harvest work losses. Tobacco production in 1980 same level as 1972.

[b]Households with members working for hire in tobacco harvest.

[c]Lost earnings as a percent of household income. Income was defined as work earnings of all household members plus interest, rents, transfer payments and similar items received.

[d]Households with unpaid members working on their own farm in harvest.

[e]No observations in this cell.

[f]Details may not equal 100 due to rounding.

in this "most prone" category.

Many households with losses over $500 are not likely to move. These can also be identified in Table 1. The likelihood of households with the head over 65 migrating because of mechanization losses is quite small.[4] Only about 13 percent fall into this category (Table 1). Migration stimulus for those losing less than 10 percent of their income would be dampened. Over 25 percent of hired households and about 10 percent of own-farm households lost less than 10 percent of their income.

Potential for migration can be translated into tentative migration numbers. If *all* households losing $500 or more migrated, 3,900 would leave the area. As the study covered 1972 to 1980 conditions, these would be distributed over an eight-year period and over eight counties. There would then be about 27 hired harvest households and 34 farm households migrating per county per year. But those 65 or over would not likely leave, reducing potential per year migration to 23 hired and 30 farm households. Going one step further and eliminating those losing less than 10 percent of gross income reduces potential out-

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[4]They may migrate because of retirement but that is a different issue if not a remote possibility.

migration to 16 hired and 27 farm households per county per year. These 43 migrating households are the result of mechanization.

Additional modifications from potential migration may be inferred from characteristics of those households most likely to migrate (i.e., losing at least 20 percent of their income). The effect of educational level on potential migration can be assessed. Education of the head is probably positively correlated with nonfarm employment opportunities. Average educational attainment of heads was less than 11 years for both types of households and for all age categories (Table 2). On the average, their migration potential based on education would appear to be limited. Receipt of transfer payments would also tend to inhibit migration, as the household would need to requalify for some programs in the new location or find work that would compensate for both loss of harvest work *and* temporary loss of welfare benefits. Differential transfer payments between regions may provide a positive stimulus for migrating, but such stimulus would most likely be stronger for those eligible for, but not receiving, transfers than for those currently receiving transfer payments. A larger percentage of hired households received transfer payments with participation decreasing with the age of head. This would tend to offset the average educational advantage of young households for potential migration.

Male-headed households may also migrate more readily than female-headed ones. The proportion of hired harvest households with a male head varied from 22 to about 75 percent. Almost all farm households were headed by a male. Blacks have historically migrated from the study area faster than whites, implying that those blacks remaining may have better access to information on alternative areas than white households. As hired households prone to migrate are primarily black, and farm households prone to migrate are primarily white, out-migration to known opportunities may be somewhat easier for hired households, *ceteris paribus*.

The authors are reluctant to attach any definite reduction in household migration as associated with household characteristics. Educational attainments for both groups are low and would impede successful migration. The predominance of income transfer payments and female-headed households would also impede migration, at least for hired households. Many farm households also have substantial investments in agricultural enterprises which would be expected to reduce potential migration. The extent to which these factors would reduce potential migration is unknown. But, there is little doubt that not all or even more of the 43 households per county per year considered as having the highest potential for migration will use migration as an alternative to lost earnings from tobacco harvest.

Reduction in demand for flue-cured tobacco is always a point of concern due to the possibility of new health-related data or increasing foreign competition in international markets. Therefore, the possibility of an extreme reduction of 50 percent in tobacco production was examined for migration impact. In general, about 70 percent of 1972 labor time would not be used under this extreme condition, but household income would decrease by only five percent for those with hired workers and 10 percent for family farm households. The number of households that would satisfy the criteria to be potential migrants had almost no effect on average characteristics of households most prone to migrate indicated in Table 2. While some bits of data would change, none of the tendencies or conclusions would be affected.

A MORE COMPLEX MODEL

The present study is unusual in that migration has been projected before its occurrence rather than

TABLE 2. POTENTIAL MIGRANT HOUSEHOLDS LOSING TOBACCO HARVEST EARNINGS OF AT LEAST $500 AND 20 PERCENT OF GROSS INCOME FOR PRODUCTION AT 1972 LEVELS: BY AGE OF HEAD AND HOUSEHOLD TENURE

		Age of Household Head			
		Less than 35	35-44	45-54	55-64
Hired harvest families					
Gross income	Dol.	5940	4380	4240	3100
After adjustment	Dol.	4570	3260	3220	2280
Average size	No.	7.5	6.6	5.2	1.5
With children[a]	Pct.	100.0	80.0	33.6	0
Number[a]	No.	3.5	3.1	1.9	0
Head's education	Yrs.	10.0	6.0	8.0	5.3
With transfer income[b]	Pct.	100.0	80.0	63.4	0
White	Pct.	0.0	17.7	0.0	0.0
Male head	Pct.	50.0	75.8	22.0	44.4
Own farm harvest families[c]					
Gross income	Dol.	5850	6470	8270	6100
After adjustment	Dol.	3840	4550	6910	4540
Average size	No.	2.9	5.7	6.4	4.9
With children[a]	Pct.	42.7	58.9	80.2	39.5
Number[a]	No.	2.0	2.8	2.2	2.5
Head's education	Yrs.	10.9	6.4	6.6	5.1
With transfer income[b]	Pct.	0	12.3	16.1	0
White	Pct.	71.0	64.2	36.9	57.4

[a]Less than 12 years old.

[b]Receiving transfer income from food stamps or other welfare payments.

[c]Almost none were headed by a female.

studied after it was completed. The projection model treated out-migration as it it could be adequately analyzed separately from other potential adjustment factors such as alternative employment, retraining or increased eligibility for transfer programs. Clearly, the decision to migrate is made simultaneously with decisions concerning other possible adjustments—both those occurring if migration is rejected and those compatible with migration.

Our present data are not completely adequate, and a more satisfactory approach would have been to construct a model in which adjustments open to workers and households are specified in such a way that the decision to migrate depended on the set of alternatives faced. Structuring the decision model would be an intellectual exercise that might lead to empirical studies from which parameters of the migration decision could be estimated and later applied to a projection problem of the sort reported here. However, the specifics of such a model are beyond the scope of this paper.

In addition to needing a model specifying the simultaneity of the decision making process, gross household out-migration estimated for the adjustment process needs to be placed in the perspective of past household migration from an area. Unfortunately, gross household or individual out-migration estimates are not available from secondary sources. And net migration estimates for individuals are not particularly useful, as in-migrants may possess characteristics and skills completely different from out-migrants. Results of this study imply a gross out-migration rate of households losing more than 10 percent of income (with heads under 65) as a result of tobacco mechanization at about two percent of all households exposed per year. The net out-migration rate of individuals computed for the study area from [1] was slightly over one percent per year, with about 98 percent of the migrants being black. This does not, however, assist one in drawing any conclusions as to whether the estimated gross out-migration rate of households is greater than or less than historical gross out-migration.

Several simplications were used in the current model which tend to overstate the estimated migration. First, projected 1980 tobacco harvest earnings were in 1972 dollars and no increase in wages was assumed for those workers still involved in the tobacco harvest. The LP models of ERS assumed farm labor wages would increase 50 percent relative to other inputs. Second, a disemployed worker from tobacco harvest was assumed to *not* find alternative employment in the area. Depending upon local job markets, at least some workers would find employment alternatives as suggested in the previous discussion of educational levels. Third, farm household harvest losses associated with mechanization were treated as if they were not offset, although it could be assumed that they would not mechanize unless they felt they would be better off (or at least no worse off) by doing so. All three of these would bias our out-migration estimates in an upward direction.

SUMMARY AND CONCLUSIONS

Concern over massive migration resulting from mechanizing the tobacco harvest, while based on historical precedent of what allegedly occurred with cotton mechanization, does not seem to be substantiated. Technological and institutional changes of the past two decades curtailed labor requirements severely before the commercial development of harvesters and bulk barns. Tobacco harvest labor force characteristics, household composition and multiple sources of income for households combine to reflect relatively small changes in household incomes from simulated mechanization. The simple one-decision migration model used here indicated a gross household out-migration rate of approximately two percent per year as a result of mechanization. A more complex model would most likely reduce the rate as alternatives to migration could be considered simultaneously.

The relative magnitudes of migration found in this report are generally applicable to the more extreme circumstances likely to exist for the flue-cured belt. The labor adjustment coefficients developed from the ERS studies were aggregates for the entire belt. An analysis of one multi-county district in the NCSU study area (five of the eight counties) in comparison with 14 others across the belt concluded that the area was "... more representative of the poorer, less prosperous, and more vulnerable ..." areas where tobacco production was concentrated [2, p. iv.].

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