Tobacco Farmer Interest and Success in Diversification

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Abstract

As U.S. farm income from tobacco production has declined in recent years, there has been increased interest in developing alternative sources of farm revenue to replace lost tobacco income, particularly in tobacco-dependent communities of the southeastern United States. The recent end of the tobacco quota program is expected to accelerate the exit of tobacco farmers and has heightened concern regarding the availability of profitable substitutes for tobacco. In this study, we examine the impact of farm, household, and market characteristics on tobacco farmer interest and success in on-farm and off-farm income diversification. Using survey data collected from a panel of North Carolina tobacco farmers in 1997, 1999, 2001, and 2004 combined with market data collected from secondary sources, we evaluate the influence of farmer preferences, resource endowments, market incentives, risk, and biophysical factors on tobacco farmers' attitudes regarding diversification into non-tobacco products, the extent to which they reallocated resources towards non-tobacco products, and their success in identifying profitable alternatives to tobacco production. Our research contributes empirical findings to the public dialogue concerning the ability of tobacco farmers and tobacco-dependent communities to adjust to structural changes taking place in the tobacco market.

Key Words: Tobacco, farm diversification, household model, quota buyout.

INTRODUCTION

Major structural changes have occurred in the U.S. tobacco market in recent years, including increased production costs; a rapid rise in the proportion of tobacco grown under contract with manufacturers; sharp reductions in tobacco marketing quotas that reflect declining demand for domestic tobacco, and, most recently, termination of the tobacco quota system and price support program, in October 2004.[1] These developments have also contributed to significant changes in tobacco-dependent communities.

Tobacco is grown in over 500 U.S. counties in 23 states, although production is concentrated in the Southern states of North Carolina, Kentucky, Virginia, Tennessee, South Carolina, and Georgia (USDA NASS, 2004). As the number of tobacco farms along with income from tobacco has declined, there has been increased interest in developing alternative sources of income, particularly in tobacco-dependent communities (Gale, 1999; Gale, Foreman, and Capehart, 2000; President's Commission, 2001; Hull, 2002).

Primary reasons for reductions in demand for domestic tobacco are reduced cigarette consumption because of higher cigarette excise taxes, higher cigarette prices to cover industry payments under settlement agreements, and antismoking efforts as well as increasing industry reliance on lower-cost imported tobacco. Removal of tobacco quotas and the federal tobacco price support program will bring U.S. tobacco prices closer to world prices making it more competitive in global markets. It will also allow geographic relocation of tobacco production (prior to the tobacco quota buyout, quotas could not be transferred across county lines, except for

[1] Effective quota for flue-cured tobacco nationally declined from 925 million pounds in 1995 to 536 million pounds in 2003, a 42 percent decline during the time period covered by our survey data collection.

burley tobacco in Tennessee). These changes are expected to speed the transition to fewer, larger farms that has taken place throughout agriculture, but which has been slowed in tobacco by the quota program. Many smaller and older tobacco farmers are likely to exit the market following the buyout (Tiller, 2003) and there may be some overall reallocation of flue-cured tobacco production towards the high-yield regions of eastern North and South Carolina and southern Georgia (Gale, Foreman, and Capehart, 2000). However, the end of the tobacco quota program is expected to accelerate the exit of tobacco farmers even in North Carolina, which accounts for approximately 40 percent of national production and is particularly well-suited for tobacco production. In our most recent survey of North Carolina tobacco farmers, conducted in early 2004, about a third of the respondents indicated they would stop growing tobacco if there were a quota buyout.

Farmers and quota holders will be receiving buyout payments over the next 10 years, but the majority will receive relatively little. It is estimated that the top 20 percent of recipients will receive about 80 percent of the total payments (EWG, 2005). Many farmers will be looking for alternative income sources, which has heightened concern regarding the availability of profitable substitutes for tobacco. The influx of buyout funds into tobacco-dependent communities could provide an opportunity for investment in new enterprises, but it has proven difficult in the past to identify sufficiently profitable alternatives to tobacco. Altman *et al* (1996) reported that their survey of tobacco farmers throughout the South found that 78 percent of tobacco farmers growing flue-cured tobacco and 69 percent of those growing burley tobacco identified the lower profits associated with alternatives to tobacco as a barrier to diversification. Our surveys of North Carolina flue-cured tobacco farmers revealed an even higher proportion identifying the

lower profitability of alternative crops as a barrier, with about 87 percent of respondents noting this as an issue.

In this study, we examine the impact of farm, household, and market characteristics on farmer interest and success in diversification into non-tobacco income. A panel of North Carolina tobacco farmers was surveyed in 1997, 1999, 2001, and 2004. Information elicited included tobacco production, attitudes, knowledge and behaviors regarding on-farm diversification, off-farm employment, tobacco manufacturers, tobacco control, and other key issues. These data were first collected prior to major upheavals in the tobacco market that have taken place since 1997. Data collection has continued to the present and includes events such as the approval of the Master Settlement Agreement between the large tobacco companies and the attorneys general of 46 states in 1998, increasing use of imported tobacco, huge reductions in tobacco quotas, rapid growth in contracting, and serious discussion regarding a tobacco buyout (our most recent survey took place prior to approval of the buyout bill).

This unique longitudinal dataset was combined with local market data to evaluate the influence of farmer preferences, resource endowments, market incentives, risk, and biophysical factors on tobacco farmers' attitudes regarding actual diversification into non-tobacco enterprises, attempts to diversify, and success in identifying profitable alternatives to tobacco. This research contributes empirical findings to the public dialogue concerning the ability of tobacco farmers and tobacco-dependent communities to adjust to the major structural changes taking place.

THEORETICAL MODEL

Following the structure of Coxhead, Shively, and Shuai (2002), we assume that farmers seek to maximize the net present value of a stream of expected utility subject to time, production function, and budget constraints. Agricultural households have the objective function

$$(1) \qquad \max \int_0^T e^{-rt} EU(t)dt$$

where r is the discount rate and the interval [0,T] defines the planning horizon. Because prices and yields are stochastic, agricultural household utility depends on the expected level of consumption, C, and its variance as well as time available for leisure, T_l, conditioned on household-specific characteristics denoted by Z_h:

$$(2) \qquad EU=U(E(C), Var(C), T_l; Z_h)$$

with typical assumptions that $\frac{\partial U}{\partial E(C)} > 0, \frac{\partial U}{\partial Var(C)} \leqslant 0$. The farm household uses their endowments of family labor, land, and land quality to produce a combination of outputs in each period under the following constraints:

(3)	$T = T_f + T_o + T_l,\ T_o \geqslant 0$	time constraint
(4)	$Q = Q(N, T_f, H_f, X, \varepsilon)$,	production function
(5)	$p_q Q + w_o T_o + V = w_x X + w_h H_f + w_n N + p_c C$	budget constraint

where

T	=	total time available to household
T_f	=	household time allocated to farm labor
T_o	=	household time allocated to off-farm labor
T_l	=	household time allocated to "leisure"[2]
Q	=	vector of farm outputs
N	=	land area
H_f	=	hired labor used on farm

[2] Includes time spent on activities other than on-farm and off-farm work, which includes child care, household chores, and other activities in addition to leisure.

X	=	vector of inputs to farm production other than labor and land
ε	=	production risk
p_q	=	vector of farm output prices
w_o	=	off-farm labor wage
V	=	non-labor income
w_x	=	vector of farm input prices other than labor
w_h	=	hired agricultural labor wage
w_n	=	land price
p_c	=	price vector for consumption goods
C	=	vector of consumption goods

It is assumed that there are two sources of uncertainty, prices and production. Prices at harvest are unknown when acreage allocation decisions are made (though input prices are observed). Production risk arises from the characteristics of the land and labor endowments as well as external events such as weather, disease, and insect infestation. Assuming no joint production, the production function for each output is assumed to be:

$$(6) \qquad Q_i = Q_i(N_i, T_{fi}, H_{fi}, X_i, \varepsilon_i)$$

where N_i is area planted to the *i*th crop, T_{fi} is household labor devoted to farming the *i*th crop, H_{fi} is hired labor devoted to farming the *i*th crop, X_i is a vector of variable inputs (fertilizer, chemicals, etc.) used on the *i*th crop, and ε_i is a random variable representing production risk. Assuming a multiplicative representation of production uncertainty, the production function can be written:

$$(7) \qquad \begin{aligned} &Q_i = \varepsilon_i Q_i(N_i, T_{fi}, H_{fi}, X_i) \\ &E(\varepsilon_i) = \mu_i; \text{var}(\varepsilon_i) = \sigma_i^2 \end{aligned}$$

Given initial land quality and other conditions, the major decisions each farmer faces at the beginning of a season are (1) the total area to plant, and (2) the fraction of planted area to allocate to each product. Farmers can respond to changes in incentives by bringing new plots

into production or leaving plots fallow, adjusting labor and other input use by crop, and adjusting land allocation among different crops. The land constraint is:

$$(8) \qquad \sum_i N_i \leqslant A_{t-1} + \Delta A$$

such that the total land in production in period t is less than or equal to the area cultivated in the previous season plus the change in area between seasons.

Incorporating the production function shown in equation (7), the current period profit function for on-farm activities can be written:

$$(9) \qquad \pi = \sum_i (p_{qi}\varepsilon_i Q_i(\bullet) - w_f T_{fi} - w_h H_{fi} - p_x X_i - p_N N)$$

where w_f represents the value of the farmers' time spent working on the farm.

Assuming price and yield risk are independent and defining expected prices as $E(P_i)=\theta_i$ and the variances of prices as $var(P_i)=\varphi_i^2$, expected profit can be written as

$$(10) \qquad E(\pi) = \sum_i [\theta_i \mu_i Q_i(\bullet) - w_f T_{fi} - w_h H_{fi} - p_x X_i - p_N N)$$

and the expected variance of profits as:

$$(11) \qquad \text{var}(\pi) = \sum_i Q_i^2(\bullet)(\varphi_i^2\sigma_i^2 + \varphi_i^2\mu_i^2 + \theta_i^2\sigma_i^2),$$

which can be more conveniently written by replacing the expression within the rightmost parentheses with $PVAR_i$.

In the case of separability (complete markets), production decisions affect consumption decisions through farm profits, but consumption decisions do not affect production decisions. Production is independent of household preferences about consumption and also independent of household income. In this case, the household behaves as if it maximizes income subject to the production function constraint and then maximizes utility subject to the full income constraint.

Because neither the value of endowed time nor exogenous non-labor income (V) are choice variables, maximizing full income is equivalent to maximizing the value of output less variable inputs (profits). The assumption of complete markets is often used for studies in developed countries. However, in the presence of risk, consumption and production decisions may not be separable where there are risk-averse farm households.

The Lagrangian function here (using constraints separately rather than the combined full income constraint in order to be able to examine the off-farm employment participation decision) can be written as:

(12)

$$L \equiv U(E(C), Var(C), T_l; Z_h) + \lambda\left[\theta_i \mu_i Q(N, T_f, H_f, X) - w_X X - w_h H_f + w_o T_o + V - p_c C\right] + \tau\left[T - T_f - T_o - T_l\right] + \mu T_o$$

Applying Kuhn-Tucker conditions:

(13) $$\frac{\partial L}{\partial C} = \frac{\partial U}{\partial E(C)} + \frac{\partial U}{\partial Var(C)} - \lambda P_c = 0$$ (assuming C>0)

(14) $$\frac{\partial L}{\partial T_l} = \frac{\partial U}{\partial T_l} - \tau = 0$$ (assuming T_l>0)

(15) $$\frac{\partial L}{\partial T_{fi}} = \frac{\partial U}{\partial E(C)}[\theta_i \mu_i]\frac{\partial Q_i}{\partial T_{fi}} + \frac{\partial U}{\partial Var(C)} PVAR_i 2Q_i \frac{\partial Q_i}{\partial T_{fi}} - \tau + \lambda\left((p_q \frac{\partial Q}{\partial T_{fi}}) = 0\right)$$ (assuming T_f>0)

(16) $$\frac{\partial L}{\partial T_o} = -\tau + \lambda w_o + \mu \leq 0, T_o \geq 0$$

(17) $$\frac{\partial L}{\partial N_i} = \frac{\partial U}{\partial E(C)}[\theta_i \mu_i]\frac{\partial Q_i}{\partial N_i} + \frac{\partial U}{\partial Var(C)} PVAR_i 2Q_i \frac{\partial Q_i}{\partial N_i} + \lambda(p_{qi} \frac{\partial Q_i}{\partial N_i} - w_n) = 0$$ (assuming N>0)

(18) $$\frac{\partial L}{\partial X_i} = \frac{\partial U}{\partial E(C)}[\theta_i \mu_i]\frac{\partial Q_i}{\partial X_i} + \frac{\partial U}{\partial Var(C)} PVAR_i 2Q_i \frac{\partial Q_i}{\partial X_i} + \lambda(p_{qi}\frac{\partial Q_i}{\partial X_i} - w_x) = 0$$ (assuming X>0)

(19) $$\frac{\partial L}{\partial H_{fi}} = \frac{\partial U}{\partial E(C)}[\theta_i \mu_i]\frac{\partial Q_i}{\partial H_{fi}} + \frac{\partial U}{\partial Var(C)} PVAR_i 2Q_i \frac{\partial Q_i}{\partial H_{fi}} + \lambda(p_{qi}\frac{\partial Q_i}{\partial H_{fi}} - w_h) = 0$$ (assuming H_f>0)

(20) $$\frac{\partial L}{\partial \mu} = T_o \geqslant 0, \mu \geqslant 0, \frac{\partial L}{\partial \mu}\mu = 0$$

With positive off-farm work (T_o>0), μ must equal 0 in order to satisfy equation (16). In other words, households with off-farm work will allocate hours to off-farm work until the expected marginal utility of allocating additional time to off-farm work is zero. Bardhan and Udry (1999) show that the first order conditions under risk imply that, at the optimum, the marginal product of household farm labor is less than the off-farm wage. This differs from the case without uncertainty, where time would be allocated to farm labor until the marginal returns to farm labor were just equal to the off-farm wage, and will result in greater reliance on off-farm labor. Because the income risk of working off-farm is less than work on-farm, a risk-averse household will allocate more of its labor to off-farm work to reduce risk, even though expected consumption is lower.

If off-farm work is zero (T_o=0), then the optimality conditions have a different structure because μ cannot be assumed to equal zero. In this case the optimality conditions are that households will allocate hours to on-farm work until the expected marginal utility of on-farm labor is equal to the shadow price of leisure. Of course, in the case of no off-farm employment, the off-farm wage rate does not exceed the shadow price of time spent farming.

The labor force participation decision depends on the relative magnitudes of w_o and w_f. When variables that raise the off-farm wage rate or lower the shadow price of time spent farming are increased, then off-farm labor participation increases. For instance, an increase in non-labor income is expected to increase the marginal value of leisure time, an increase in output price generally increases the value of time spent in farm work and an increase in input price lowers the shadow price of farm labor.

The land area allocated to each crop is an increasing function of expected own-price and yield. Cross-price and cross-yield effects are typically negative because acreage in one crop is generally a substitute for acreage in another crop, although there may be complementarities due to rotation patterns. In addition, uncultivated land, if present on the farm, could be used to increase crop acreage. Under risk neutrality, price and yield shocks should dominate the explanation of changes in total acreage planted and acreage allocation among crops over time. Land allocation by crop is invariant to own price and yield variability. However, under risk aversion, the sign associated with own variance is unambiguously negative. For positive price or yield shocks for a crop, risk-neutral farmers will expand area of that crop by more than risk-averse farmers because an increase in production of a given crop increases the variance in income associated with that crop. In addition, increasing variability of yields and/or prices is expected to increase the amount of time allocated to off-farm work. As the returns to tobacco have declined in recent years, it is expected that farmers would respond by increasing the area devoted to alternative crops and spending more time working off-farm.

The system of equations above can be used to obtain optimal values for N_i, T_l, T_o, T_{fi}, H_f, X, λ, τ, and μ. Given observed data, we can construct a set of reduced form equations that provides a solution for the endogenous variables. The focus here is on the allocation of land to

tobacco vs. alternative enterprises and the allocation of time to off-farm work because we are interested in income diversification away from tobacco.

Reduced form equations for econometric estimation can be written in the general form:

$$(21) \qquad N_i = N_i(\theta_i, \varphi_i^2, \mu_i, \sigma_i^2, w_h, p_x, w_o, A_{t-1}, Z_h)$$

$$(22) \qquad T_o = T_o(\theta_i, \phi_i^2, \mu_i, \sigma_i^2, w_h, p_x, w_o, A_{t-1}, Z_h).$$

These equations were estimated empirically from several regressions. One used tobacco acreage grown (ACRESGROWN) as the dependent variable, N_i. Others employed probit regression and measures of T_o that are binary indicators of whether the farmer is actively searching for ways to diversify their operations or not (ACTIVE); whether respondents indicated finding ways to increase profits in any of their non-tobacco enterprises (INCPROFIT); and whether the farm household has off-farm income (OFFFARM).

DATA

The primary data source for this paper is a panel of North Carolina tobacco farmers. The panel was drawn from 14 of the 15 counties that produce the most flue-cured tobacco in the state and surveyed in 1997, 1999, 2001, and 2004 to date. Some of the questions in each of these surveys asked farmers for information about the previous two years. Thus, we have observations for selected variables (e.g., tobacco acreage) for up to eight years. There were 1,236 tobacco farmers in the initial sample, but there has been substantial attrition over time. In the most recent survey, there were 535 farmers that responded to the survey and that continue to have tobacco-related income. These data were combined with secondary data on wages and crop prices and yields.

The data used to implement the above model empirically fall into the following five basic categories (variables used in theoretical model section in parentheses):

Household-specific Characteristics (Z_h): Household preferences are not measured directly, so they are proxied using demographic and other variables expected to influence farm household preferences and managerial ability. The variables used in the empirical analysis are age of household head[3] (AGE); age of household head squared (AGESQ); dummy variables for household head educational attainment categories (less than high school (ED_LTHS), high school graduate (ED_HS), some college (ED_SOMECOLL), and college graduate (ED_COLLGRAD)); a dummy variable for household head gender (MALE); a dummy variable for household head race (WHITE); a dummy variable for household head tobacco use (TOBACCO), and a dummy variable indicating whether the household was in a county that received targeted information regarding opportunities to diversify away from tobacco from the Rural Advancement Foundation International and other partners (TX). All of these variables were collected from survey respondents except for TX, which was assigned based on the county where the farm household was located.

Resource Endowments (T, A): These variables measure the resources available to the landowner and include asset holdings such as land, labor, and wealth (proxied by income).[4] The labor variables used to represent these characteristics include dummy variables for whether the household head is married (MARRIED) and whether they have children (CHILD), both of which are included to proxy additional time endowment for the household because the survey did not directly collect data on the number of members of each household and their ages. Total acreage

[3] For the purposes of this study, the household head is the person within the household that makes decisions regarding tobacco production.

[4] In the absence of capital constraints, wealth should theoretically not be an important determinant of landowner behavior.

owned (TOTALLAND) was only collected in the 2004 survey and was assumed to be constant across the survey period. Annual household income data was collected in ranges and is categorized for the purposes of this analysis into four categories, income less than $25,000 (INC_LT25K), between $25,000 and $50,000 (INC_25TO50K), between $50,000 and $100,000 (INC_50TO100K), and greater than $100,000 (INC_GT100K).

Market Incentives (θ, w_h, w_o, p_x, r): This category includes factors explicitly related to exogenous economic determinants of decisions, such as prices, availability of markets, and infrastructure. We used future harvest period tobacco prices to represent tobacco price expectations (Foreman, 2005). Due to lack of cross-sectional price variation, we substituted expected revenue for prices based on multiplying the expected price by the yield reported by the survey respondents. For those that did not report their yield, we used the average yield for respondents from that county. ER_TOB is the expected tobacco revenue per acre.[5]

To proxy for off-farm labor opportunities, we used the average wage per job for each county for each year (OFFFARM), downloaded from the BEA Regional Economic Accounts (BEA, 2005). The 90-day T-bill rate (R) was used as a measure of investment opportunity costs. One of the most important input costs for tobacco growers is leasing quota. We used lease prices reported by survey respondents for 2002 and 2003 and scaled them back to earlier years based on the national cost for land and quota divided by the average yield (Foreman, 2005). This assumes that all lease rates were changing at the same rate while maintaining their distribution across

[5] We also attempted to use World Agricultural Supply and Demand Estimates price projections (USDA NASS, 2005) for several major NC crops to capture crop substitution. Analogous to the case for tobacco, we substituted expected revenue for prices. However, in this paper we focus on the results with only tobacco price and variability included.

particular farms. For households that did not report a lease price (most of whom reported that they did not lease from or to others), we used the average of reported lease prices per pound for their county to represent the lease price that would have been available to them had they chosen to enter the quota lease market.

Risk and Uncertainty (φ_i^2, σ_i^2): These variables reflect the uncertainty in the market and institutional environment under which decisions are made, primarily yield and price risk. There has been relatively little variation in the tobacco price in recent years, due in large part to the programs in place to stabilize it. The variance of the tobacco price over the period from 1995 to 2003 was multiplied by the yield for each farm to provide a measure of variability in expected revenue due to price variability, holding yield constant (ERV_TOB). This was used in order to have cross-sectional variation. In addition, the variance of yield over the period from 1960 to 2003 by county was used to represent the yield risk for that county (TOB_YVAR).

Biophysical Factors (μ_i,): This refers to influences on the physical production process associated with farming. However, the farmer survey did not collect information on slope, soil quality, or other biophysical factors. Consequently, we used tobacco yield reported by respondents to proxy soil quality for growing tobacco. Yield information was not collected before the 2004 survey, so yield in previous years was assumed to be equal to the average of the yields reported in the 2004 survey for the 2002 and 2003 seasons.

In addition to the variables described above, there are a number of existing or potential government policies that could influence landowner decisions. These policies could enter through adjustments to expected prices (e.g., due to price supports), price variability (e.g., through price supports, crop insurance), or through dummy variables representing the presence of a policy. Of course, the most important policy that may have affected decisions regarding

tobacco production over this time period is the tobacco quota program. Since these policies are all implemented at the national or market level, the only variation in them is over time. For this reason, we use time dummy variables to capture changes in quota and other policies.

RESULTS

Table 1 summarizes the data used for this analysis. Farmers were predominantly white (94%) and male (92%) with just over 50% having a high school diploma or less. Most are married (87%) and have at least one child (92%). Just over 50% worked off-farm; 45% reported making a profit on some crop other than tobacco; and two thirds (67%) indicated active attempts to diversify income. Ages ranged from 19 to 92 years with average age just over 50 years. Forty-one percent report smoking. Average farm size is around 300 acres, while acres of tobacco grown averages only 56 acres.

The results of the regressions with tobacco acreage grown as the dependent variable are shown in Table 2. Because some of the farmers in the sample lease out all of their quota and their tobacco acreage grown is censored at zero, we used a random effects Tobit model. Because tobacco quota is an important constraint in this market, we estimated the equation both with and without including the total acreage owned because farms that are larger in size cannot necessarily increase their tobacco acreage more than small farms. Although the signs on expected tobacco revenue (ER_TOB) and yield variance (TOB_YVAR) are opposite of what would be expected, off-farm wages, interest rates, and lease price coefficients show the anticipated response to changes in market conditions. The dummy variables for survey years reveal a strong downward trend after 1999, reflecting the severe quota cuts that were implemented over that time. Changes in coefficients when total land owned in 2004 is included suggest that this variable is highly correlated with being male, white, married, and having a college degree and at least one child.

In addition to the tobacco acreage regressions, we also estimated probit models of efforts and success in diversification on-farm as well as participation in off-farm work. Table 3 summarizes the results, which do not always conform to expected results. Responses to economic incentives generally appear quite weak in these regressions, although this may be a function of the data that we used to proxy expected prices facing farm households.

Our results show that whether a farm household is actively attempting to identify opportunities for diversification (ACTIVE) is most strongly correlated with education level of high school graduate or above. This finding supports our conjecture that this variable may be associated with managerial acumen. The time dummies show that interest in diversification has increased relative to 1997, but has remained fairly constant in each successive year. The slight elevation in 2001 may reflect increased interest following the Master Settlement Agreement in 1998 that raised prices and reduced demand. That interest may have been dampened by 2004 by Phase II payments and increased talk of a buyout which would have increased farmers' incentives to continue to grow tobacco. This may explain why efforts to diversify are not strongly related to economic incentives in our results. The second column of Table 3 contains coefficient estimates for the regression of diversification profitability. There are few significant variables in this regression. Total acres of land owned is a positive predictor of profitability, while tobacco use is a negative predictor. One of the most interesting things in this regression is that the time dummy coefficients, which in 1999 and 2001 demonstrate a fairly uniform negative shift relative to 1997, nearly double in absolute magnitude in 2004. This would be consistent with increased expectations of a buyout plus receipt of Phase II payments which may have dampened farmer interest in identifying ways to increase profits on non-tobacco.

Finally, in the OFFFARM model, we find age and age squared to be important determinants of whether the household derives income from off-farm sources, as expected. Education levels of high school graduate and above are also correlated with higher probability of having off-farm income, as is having at least one child. The difference in coefficients between individuals with some college and those with a college degree suggest that the former group are much more likely to work off-farm compared to those without a high school diploma than are those farmers who have a college degree. There are at least two possible explanations for this finding. Individuals with college degrees may be more risk neutral or, if they are risk averse, their additional managerial acumen may result in higher on-farm productivity and a higher off-farm reservation wage. None of the economic variables is statistically significant in this regression..

DISCUSSION

Changes taking place in tobacco markets have increased interest in identifying potential substitute income sources for tobacco farmers. Our econometric findings suggest that farmers' decisions about tobacco acreage grown are shaped in expected ways by their economic opportunity set as measured by off-farm wages, tobacco quota lease prices, and interest rates. Our model predicted that this decision would also be affected by expected returns to tobacco and tobacco yield variance. The empirical results indicate that this is the case, but the signs of these effects are opposite of expectations. This may be due in part to the imperfect measures of these variables available for this study, but may also reflect the impact that the potential quota buyout had on farmers over this period that was not entirely captured by the year dummies. It is likely that some farmers stayed in tobacco longer than they would have otherwise in an attempt to be eligible for a tobacco buyout in the event one took place. This may have made them less

responsive to price and risk signals. However, this would not account for the opposite and significant effects detected here. There has been relatively little change in tobacco prices recently, but there has been a substantial increase in tobacco quota lease rates as quotas were reduced. If farmers' responses to rising lease rates dominated responses to changes in output prices or its variability, this could account for the findings presented here. Lease rates were a major input cost prior to the tobacco quota buyout and it is not surprising that they had a significant impact on tobacco acreage grown.

The results suggest that farm households are becoming more interested in diversifying their income over time, but less successful in finding ways to accomplish that goal with alternative enterprises on farm. Increased interest in diversifying is certainly consistent with market changes that have tended to signal the end of the tobacco price support system and increased foreign competition. The confounding influence of the impending tobacco quota buyout, which created incentives to grow tobacco in order to qualify for buyout payments, could account for some of the decrease in developing profitable alternatives and working off-farm over time that is observed. However, it is unlikely to be the full explanation. North Carolina also suffered sizable losses in manufacturing jobs between 2001 and 2004, thus restricting the opportunity set for off-farm employment. This has almost certainly translated into reduced demand for produce and other farm products, at least in local markets, which would in turn affect profitability.

Researchers, agricultural development policymakers, and public health advocates have been working for decades to encourage development of value-added and specialty products that would enable farms to become diversified away from tobacco while maintaining or increasing their profitability. Further post-buyout research is needed to sharpen estimates of tobacco

farmers' responsiveness to economic incentives. A new version of the tobacco farmer survey will be fielded in late 2005 that will help to resolve questions about tobacco farmers' actions once price supports are no longer in place and whether buyout funds are sufficient to enable them to develop new economic opportunities.

References

Altman, D.G., D.W. Devine, G. Howard, and H. Hamilton. 1996. "Tobacco Farmers and Diversification: Opportunities and Barriers." *Tobacco Control* 5(1996):192-198.

Altman, D.G., D.W. Devine, G. Howard, and H. Hamilton. 1997. "Tobacco Farming and Public Health: Attitudes of the General Public and Farmers." *Journal of Social Issues* 53(1):113-128.

Barnham, P. and C. Udry. 1999. *Development Microeconomics*. Oxford University Press: Oxford, UK.

Brown, A.B., W.M. Snell, and K.H. Tiller. 1999. "The Changing Political Environment for Tobacco—Implications for Southern Tobacco Farmers, Rural Economies, Taxpayers, and Consumers." *Journal of Agricultural and Applied Economics* 31(2):291-308.

Bureau of Economic Analysis. 2005. *Regional Economic Accounts.* Available at http://www.bea.doc.gov/bea/regional/reis/.

Coxhead, I., G. Shively, and X. Shuai. 2002. "Development Policies, Resource Constraints, and Agricultural Expansion on the Philippine Land Frontier." *Environment and Development Economics* 7(2):341-364.

Environmental Working Group (EWG). 2005. "EWG Analysis of House Tobacco Buyout Bill." As obtained from http://www.ewg.org/farm/tobaccobuyout.php?page=analysis on April 25, 2005.

Foreman, L.F. 2005. "Production Costs and Returns for Tobacco in 2003." Economic Research Service, U.S. Department of Agriculture, Report TBS-258-01. May 2005.

Gale, F. 1999. "Tobacco Communities Facing Change." *Rural Development Perspectives* 14(1): 36-43.

Gale, H.F., L. Foreman, and T. Capehart. 2000. "Tobacco and the Economy: Farms, Jobs, and Communities." Economic Research Service, U.S. Department of Agriculture, Agricultural Economic Report No. 789.

Hull, J.W. 2002. "Tobacco in Transition." Special Series Report of the Southern Legislative Conference. Southern Office, Council of State Governments: Atlanta, GA.

The President's Commission on Improving Economic Opportunity in Communities Dependent on Tobacco Production While Protecting Public Health. 2001. *Tobacco at a Crossroad: A Call for Action.* USDA: Washington, D.C.

Tiller, K.H. 2003. "U.S. Tobacco Economic and Policy Outlook." Agricultural Policy Analysis Center, Department of Agricultural Economics, The University of Tennessee.

Tiller, K.H. and J.G. Brown. 2002. "Proposed Tobacco Quota Buyout Legislation: Effects on Tennessee Tobacco Farms." Agricultural Policy Analysis Center, Department of Agricultural Economics, The University of Tennessee.

U.S. Department of Agriculture, National Agricultural Statistics Service (USDA NASS). 2004. *2002 Census of Agriculture*, Volume 1, Geographic Area Series Part 51, Chapter 2, State Data, Table 1, State Summary Highlights: 2002. USDA: Washington, D.C.

U.S. Department of Agriculture, National Agricultural Statistics Service (USDA NASS). 2005. *World Agricultural Supply and Demand Estimates.* Available at http://usda.mannlib.cornell.edu/reports/waobr/wasde-bb/.

Zhang, P. and C. Husten. 1998. "Impact of the Tobacco Price Support Program on Tobacco Control in the United States." *Tobacco Control* 7(1998):176-182.

Table 1. Descriptive statistics for variables used in estimation

Variable	Mean	Standard Deviation	Minimum	Maximum
ACRESGROWN	55.70	61.32	0	760
ACTIVE	0.6764	0.4679	0	1
INCPROFIT	0.4543	0.4980	0	1
OFFFARM	0.5147	0.4998	0	1
AGE	53.07	11.98	19	92
AGESQ	2,959.68	1,311.65	361	8,464
MALE	0.9230	0.2667	0	1
WHITE	0.9412	0.2353	0	1
ED_LTHS	0.1319	0.3385	0	1
ED_HS	0.4146	0.4927	0	1
ED_SOMECOLL	0.2381	0.4260	0	1
ED_COLLGRAD	0.2154	0.4111	0	1
TOBACCO	0.4075	0.4914	0	1
MARRIED	0.8659	0.3408	0	1
CHILD	0.9152	0.2786	0	1
TOTALLAND	292.72	537.17	0	4,000
ER_TOB	4,348.74	1,712.57	0	21,605.07
ERV_TOB	103.05	40.09	0	468.69
OFFWAGE	13.06	1.714	10.02	19.03
P_LEASE	0.4874	0.2180	0.1469	2.6
TOB_YVAR	191.97	22.16	151.63	230.36
R	4.122	1.731	1.01	5.82

Table 2. Results for Tobit Regression of Tobacco Acreage Grown

	(1)	(2)
AGE	-0.4568***	-0.8525***
	(-4.94)	(-8.01)
MALE	12.22***	20.94***
	(3.82)	(6.79)
WHITE	5.131	42.04***
	(1.50)	(11.93)
ED_HS	6.254**	7.002**
	(2.32)	(2.28)
ED_SOMECOLL	-0.4755	3.758
	(-0.18)	(0.90)
ED_COLLGRAD	2.234	23.16***
	(0.68)	(7.25)
TOBACCO	-4.112**	-8.891***
	(-2.20)	(-5.04)
MARRIED	4.453**	10.96***
	(1.97)	(3.71)
CHILD	6.813**	17.99***
	(2.39)	(4.55)
TOTALLAND04	0.05878***	
	(42.3)	
ER_TOB	-0.0003365	-0.00272***
	(-0.52)	(-5.84)
OFFWAGE	-2.309***	-1.544**
	(-3.45)	(-2.36)
R	-3.948***	-3.903***
	(-2.92)	(-2.65)
P_LEASE	-8.348***	-6.220**
	(-2.57)	(-2.14)
TOB_YVAR	0.0287	0.2164***
	(0.68)	(4.96)
SYR99	4.639***	3.090**
	(3.10)	(1.99)
SYR01	-8.661***	-10.02***
	(-5.06)	(-6.04)
SYR04	-29.92***	-31.72***
	(-5.31)	(-5.25)
Intercept	84.67***	33.39**
	(5.27)	(2.38)
σ_u	45.54***	59.24***
	(67.6)	(68.42)
σ_e	27.82***	30.35***
	(78.8)	(80.02)
ρ	0.7282	0.7921

Note: Z-statistics are in parentheses. Superscripts ***, **, and * denote statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

Table 3. Results for Probit Regressions of Diversification Activities

	Dep. Variable ACTIVE	Dep. Variable INCPROFIT	Dep. Variable OFFFARM
AGE	-0.000111	0.03173	0.2878***
	(-0.00)	(0.97)	(5.29)
AGESQ	-0.0000123	-0.0003802	-.0003284***
	(-0.04)	(-1.25)	(-6.27)
MALE	-0.4830**	0.04156	0.1704
	(-2.31)	(0.19)	(0.55)
WHITE	-0.3811	-0.2819	-1.054**
	(-1.51)	(-1.12)	(-2.27)
ED_HS	0.5697***	-0.0610	0.5554*
	(3.29)	(-0.33)	(1.67)
ED_SOMECOLL	0.5692***	-0.04432	1.163***
	(3.05)	(-0.23)	(3.26)
ED_COLLGRAD	0.6777***	0.1469	0.8864**
	(3.45)	(0.73)	(2.36)
TOBACCO	0.1071	-0.1950*	0.0509
	(1.06)	(-1.92)	(0.30)
MARRIED	0.4015**	0.1351	-0.1630
	(2.54)	(0.82)	(-0.54)
CHILD	-0.05487	0.06503	1.668***
	(-0.28)	(0.33)	(4.60)
TOTALLAND04	0.0001364	0.0001761*	
	(1.27)	(1.72)	
ER_TOB	0.0003486	-8.47e-06	-0.0000557
	(0.92)	(-0.24)	(-0.95)
ERV_TOB	-0.01409		
	(-0.87)		
OFFWAGE	0.02441	-0.0328	0.05387
	(0.76)	(-0.99)	(0.98)
P_LEASE	0.2800	-0.1499	0.5896
	(1.03)	(-0.54)	(1.33)
TOB_YVAR	-0.005506**	0.001983	-0.003347
	(-2.17)	(0.74)	(-0.69)
SYR99	0.4545***	-0.3351***	-0.02307
	(2.59)	(-2.94)	(-0.17)
SYR01	0.5479**	-0.3459***	-0.1464
	(2.39)	(-2.80)	(-0.90)
SYR04	0.4538	-0.6671***	-0.3182*
	(1.63)	(-5.33)	(-1.84)
Intercept	0.7460	-0.1763	-6.684***
	(0.68)	(-0.16)	(-3.74)
σ_u	0.8812***	0.7613***	1.921***
	(11.88)	(9.85)	(12.84)
ρ	0.4371	0.3669	0.7868

Note: Z-statistics are in parentheses. Superscripts ***, **, and * denote statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively.