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Abstract:
This study addresses the question of whether farms enrolled in land preservation programs are actively engaged in agricultural or conservation activities. Data are drawn from an original survey administered to preserved farm owners in the states of New Jersey, Maryland, and Delaware in 2011. "Actively engaged" is defined as investment in conservation projects, buildings, equipment, or irrigation since the land was preserved. Affirmative answers to the survey's investment questions range from a low of 19% for irrigation to a high of 69% for equipment. Special attention was paid to differences between lifestyle farmers and small and large commercial farmers, which are classified using the USDA typology developed in 2000. Regression analysis estimates differences in investment behavior across these groups as well as farm tenure categories, controlling for farm size, program/state location, and demographic variables. Only owners who employ tenants or managers exclusively on their land were found to invest significantly less than the largest professional farmers, and they did so across all four types of investment.

This study's findings support preservation goals articulated by legislators and program administrators, because (1) agricultural and land stewardship investments appear to be widespread on preserved farms, partly due to administrators' preference for larger parcels, (2) there is no evidence that "hobby farmers" are disproportionately attracted to farmland preservation programs – in fact the opposite seems to be true – while those that exist in our sample behave similarly to the largest commercial farmers, (3) although tenant farming is associated in the sample with lower rates of investment, it is less common on preserved farms than on all farms in the three study states. The matter of land tenure, highlighted in this as in other studies, has not yet become a primary focus of either farm-behavioral research or state agricultural policy.

Introduction

In countries throughout the world, the preservation of prime farmland in the face of urbanization remains a high priority goal, albeit one that is difficult to achieve (Alterman, 1997; Nelson, 1990; Bengston et al., 2004; Prokop et al., 2011; Lichtenberg and Ding, 2008; Verzandvoort et al., 2009). Because North Americans are especially protective of the development rights traditionally held by landowners, they have pioneered voluntary farmland preservation programs, including some that involve a significant outlay of public funds. Twenty-seven U.S. states have state-level farmland preservation programs in which the government purchases either land or its development rights in the form of conservation easements (American Farmland Trust, 2013). In both of these cases, the state legally prevents development. When only the development rights are sold, the landowner and all subsequent owners have a contractual restriction on development written into the deed of ownership. This is the most common approach to permanent preservation taken by states in the U.S. (Daniels and Bowers, 1997).[1]

Understandably, U.S. states with rapidly growing megalopolisscale development are at the forefront of farmland preservation. The present paper will evaluate farmland preservation programs in three of these states: New Jersey, Delaware, and Maryland. These states lie on the busy northeast transportation corridor that connects New York City to Washington, D.C. In this paper, we evaluate farmland preservation programs not on the number of acres they preserve, but rather on the nature of activities taking place on the land after preservation. To this end, we report original survey data on investment activities. These include investments related to the environment, like soil conservation, and those related to agricultural production, like irrigation and the construction of farm buildings. These post-preservation investment activities have significant environmental, landscape, and economic effects. They should be of considerable interest to both farmland policy makers and land use planners, although they are little studied.

Post-preservation investment activity will also be evaluated through the lens of a standard U.S. federal farmer typology that includes categories such as full-time farmer, lifestyle farmer, and retired farmer, as well as scale of operation (Hoppe et al., 2000). A large literature exists on the relationship between on-farm business decisions and farm or farmer characteristics that include all of these traits, as well as tenancy/absentee ownership (Soule et al., 2000; Lambert et al., 2007; Wilson et al., 2013). A significant subset of this literature is concerned primarily with conservation or environmental practices (Clearfield and Osgood, 1986; Tavernier and Tolomeo, 2004; Soule, 2001; Sassenrath et al., 2010; Petrzelka et al., 2013). In fact, most studies in agricultural economics that focus on traditional capital investments like equipment and buildings are designed to test hypotheses about financial decision-making or federal farm policies. This makes them less useful as background for an analysis of farming and stewardship behavior across operator types (see, e.g., Weersink and Tauer, 1989; Gustafson et al., 1988;
Feder et al., 1992; Elhorst, 1993).

A separate literature explores the political determinants of farmland preservation programs, as well as their impacts (Daniels, 1999; Nickerson and Hellerstein, 2003; Kline and Wichelns, 1996; Heimlich, 2001; Duke and Ilvento, 2004a; Sokolow, 2006; Towe et al., 2008; Lynch and Musser, 2001; Lynch and Liu, 2007; Liu and Lynch, 2011). The bulk of this literature, however, evaluates farmland preservation programs on the basis of land preservation alone, rather than on post-preservation activities by owners or tenants. A rare exception to this rule is Lynch (2007).

One obvious topic of study within this literature is the ability of a preservation program to reduce rural-urban spatial fragmentation and contribute to farmland 'critical mass' (Daniels, 1986, 1999; Daniels and Nelson, 1986; Brabec and Smith, 2002; Nickerson and Hellerstein, 2003; Lynch and Carpenter, 2003; Sokolow, 2006). Researchers have also looked at the impact of deed restriction on post-preservation land prices, reasoning that significantly lower prices could induce a new generation of farmers to buy and farm land (Nickerson and Lynch, 2001; Lynch et al., 2007; Anderson and Weinhold, 2008; Stobbe et al., 2009; Schilling et al., 2013). Finally, a few authors have looked at parcel and landowner characteristics that affect the likelihood of participating in preservation programs (Duke, 2004; Lynch and Lovell, 2003; Duke and Ilvento, 2004b). For example, Lynch and Lovell (2003)

found that the likelihood of participation increases with farm size, growing crops, if a child plans to continue farming, and the share of income from farming.

All but missing in the farmland preservation literature is the question of whether today's post-preservation owners are actively engaged in farming or environmental stewardship activities. Such activities are encouraged, but are not generally required, by the deeds of easement and by the programs' founding statutes. Furthermore, if some owners of preserved farms are actively farming (or conserving) and others are not, we have little idea what kind of farmer/owner falls into these two groups. This kind of information could help policy makers target preservation activities to particular types of landowners in the future.

This gap in the agricultural economics and land use policy literatures is surprising in light of the fact that: (1) state level conservation easement programs have protected more than 2.37 million acres nationwide, (2) as much as 28% of all farmland in a heavily urbanized state like New Jersey is currently subject to permanent deed restriction, and (3) active agriculture and the continuing supply of local food is an important goal of the legislation that set up state farmland preservation programs in the first place. As public budgets have gotten tighter since the 2008 recession, and residential construction has slowed, it is only natural that farmland policy makers turn at least some of their attention away from land acquisition and toward issues of post-preservation stewardship and production.

This article bridges the literatures on the policy impacts of farmland preservation programs and the agricultural investment behavior of different types of farmers. With the help of a customized survey dataset, its goal will be to address the increasingly important issue of stewardship – whether for ecosystem services or for local food production – on permanently preserved farms.

Theoretical predictions

A major theoretical prediction is that farmland preservation will increase land-oriented investment by eliminating the so-called "impermanence syndrome" that causes landowners to stop making investments on land that is expected to develop within a short time horizon (Heimlich and Anderson, 1987; Adelaja et al., 2011; Lopez et al., 1988). In theory, permanent deed restriction could cause a farmer who had previously intended to stop investing to begin doing so.[2] In practice, farmers who enter preservation programs know very well that their time horizons in agriculture will be extended. They are either already comfortable with this fact (Lynch and Lovell, 2003; Duke and Ilvento, 2004b); or they may plan to exit agriculture and sell the restricted parcel to somebody who is intentionally buying permanence. From the policy makers' point of view, it does not matter much whether the owners of preserved farms assume a long investment horizon before they enter the program, or afterwards. In either case, the theoretical prediction is for greater agricultural investment on preserved farms than on unpreserved farms when both are located in rapidly urbanizing areas.

A second theoretical prediction runs in the opposite direction and is based almost entirely on a selection rather than a treatment effect. It could be that so-called hobby or lifestyle farmers are disproportionately attracted to farmland preservation programs because they have a strong preference for rural landscape preservation rather than production (Layton, 1978; Primdahl, 1999; Gill et al., 2010; Lynch and Lovell, 2003). Full-time farmers, focused more on profitability, may lack this strong preference. This is not a hard and fast rule: full-time commercial farmers are certainly not insensitive to such things as scenic vistas and rural character (Sadler, 2008; Mills et al., 2013; Duke, 2004). Thus, large commercial farmers with deed restrictions could have attitudes that are similar to those of hobby farmers who put their parcels into preservation.

This latent self-selection into farmland preservation may be associated with particular commodity choices – horses on grassy pastures with picturesque fences, for example (Layton, 1978; Boyd, 1998). It may lead to a disproportionate emphasis on conservation or landscape investments, more 'extensive' agricultural land uses, or such features as hedgerows in the European context (Layton, 1978; Kristensen, 1999; Primdahl, 1999; Gill et al., 2010).

Other potential selection effects lead to a prediction of less overall investment for program participants than for non-participants. If lifestyle farmers are disproportionately attracted to preserva-

tion programs, an obvious concern is that they will invest less in their operations because of their part-time status or lack of business acumen (Daniels, 1986; Lambert et al., 2007; Ceddia et al., 2009). A disproportionate number of participants could be seeking to "cash out" a portion of their land asset as part of a transition toward retirement. This group would presumably be less interested in active farming. They might be counter-balanced, however, by a second group that enters the program to use easement sale proceeds to finance agricultural investment (Lopez et al., 1988; Duke and Ilvento, 2004b; Lynch, 2007).

Self-selection by program participants interacts with formal or informal parcel selection by program administrators. With a heavy focus on critical mass and a desire to minimize transaction costs, program administrators typically target larger farm parcels for preservation. Larger parcels are more likely to engage in certain types of investment (e.g., irrigation) for reasons that have little to do with owners' personal preferences (Skaggs and Samani, 2005). Program administrators may unintentionally give preference to large commercial farmers who are in their professional networks – especially if the program is run by a state department of agriculture rather than by an environmental agency or trust. The programs' structure also requires trade-offs between objectives and constraints. For example, programs seek to preserve agricultural land and provide ecological services, but must attract landowner participation and meet their budgetary constraints (Lynch, 2009).

The present study will use a regression approach to control farm attributes, like size and commodity choice, in order to focus attention on the federal farmer typology. At the same time, it is important to report the simple distribution of farm attributes within our sample of preserved farms, precisely because they will drive investment and stewardship behavior in the aggregate.

From a scientific perspective, we are left with a set of cross-cutting hypotheses, e.g., longer production time horizons permitting the addition of new capital, versus more passive activities by lifestyle farmers. Latent selection effects also run in opposite directions when analyzed from the perspective of program participants (less landscape-altering investment) and program administrators (more production-oriented investment). Many of these cross-cutting hypotheses involve an implicit comparison of farms in preservation programs to farms that are not enrolled in such programs. Because the survey developed for this study was only administered to program participants, we must make the relevant empirical comparisons using (1) data from the federal Census of Agriculture, to the extent it is comparable and (2) findings from the literature on the investment behavior of unpreserved farms (or more accurately, farms with unknown preservation status) across standard farm typologies. Given the breadth of the prior literature, this second approach works quite well. To better contrast our own findings to those of the prior literature, we will omit a stand-alone review of the empirical literature, and instead describe the relevant findings from the prior literature immediately alongside each of our own key results.

In summary, our unique survey data, analyzed using descriptive statistics and regression techniques, is well suited to answering the ultimate question that should be on the minds of farm policy makers: Taking into account all of the selection and behavioral effects of our programs, is there anything to worry about with respect to the mix or intensity of post-preservation activities on preserved farms? The short answer to this question is no, as we shall see.

Appendix A describes in detail the five preservation programs we have studied in the three northeastern states, quoting the statutory objectives related to conservation and agricultural production. This material shows that the outcomes we are evaluating are, in fact, stated objectives of the programs. This appendix also provides background on each program's administrative selection criteria. This material helps us to better understand the nonrandom aspects of our sample of preserved farms.

The section that follows describes our survey approach, and then uses the Census of Agriculture to compare our sample with the universe of farms in the states of New Jersey, Delaware, and Maryland. A description of the regression analysis of the survey data follows, along with an extensive discussion of results. The concluding section explores implications of this work for land preservation policy making and for future research.

Survey approach and characteristics of the preserved farm sample

Data were collected through telephone surveys of preserved farm owners distributed across five conservation easement programs in the three states of New Jersey, Maryland, and Delaware. Computer-assisted telephone interviews were conducted by trained enumerators at the University of Nebraska-Lincoln's Bureau of Sociological Research from mid-July 2011 to mid-January 2012.

The sampling frame comprised 5319 unique landowners that had preserved farmland under, or acquired farmland preserved under, the Delaware Agricultural Land Preservation Foundation, Maryland Agricultural Land Preservation Foundation, Maryland Environmental Trust, Maryland Rural Legacy Program, or New Jersey Farmland Preservation Program. This survey was intended to support a number of different analyses, including some that would calculate point estimates, and others that would estimate causal relationships using regression. Our goal was to achieve a respectable confidence interval (i.e., ±5% or better) that would allow the calculation of statistically reliable point estimates. The challenge was to optimize sample size and survey length within the constraint of our survey budget. Our target sample size was ultimately set at n = 500, which would support point estimates within a ±4% confidence interval (at the 95% confidence level).

Our experience with past surveys suggested that approximately 950 owners would need to be contacted to yield our preferred sample size of 500 or greater. After removing duplicates from the combined mailing lists, a total of 942 randomly selected landowners (17.7% of the sample frame) were mailed a letter that introduced the study and asked for their participation. A total of 507 owners completed the half-hour telephone survey, for a response rate of 53.8%. The sample proportions across programs aligned well with their respective sampling frame proportions.

Table 1
Distribution of farmer types among operators only: sample of preserved farms compared to Census universe.

	Preserved farm sample		All three states, 2007 Census of Agriculture	
	Frequency	Percent	Frequency	Percent
Full time farmer, ≥$250K sales	64	23.9%	2697	11.1%
Full time farmer, <$250K sales	87	32.5%	7760	31.9%
Lifestyle farmer (part-time, <$250K)	117	43.7%	13,900	57.1%
	268	100.0%	24,357	100.0%

Table 2
Average land area: preserved farm sample versus Census universe.

	Average of reported acres in preservation programs (sample survey)	Average farm size in acres (2007 Census of Agriculture)
New Jersey	138.6	71.0
Delaware	383.0	200.4
Maryland	217.0	159.9

Study sample compared to the Census of Agriculture

Table 1 compares the distribution of farmer types in our sample of preserved farms to population data for all farms in Maryland, New Jersey, and Delaware, using the 2007 Census of Agriculture. To be included in this table, an operation in our survey had to report at least some agricultural production – otherwise it could not be compared to the Census of Agriculture. For the present study we surveyed landowners, while the Census of Agriculture surveys 'farms.' The respondents reached by the Census are therefore comparable to the subset of our respondents who declared themselves to be 'operators.' For this reason, the data in Table 1 describing our three-state sample are restricted to operators. This is the group for which we have sales data that allow us to replicate the standard federal typology used in the Census of Agriculture (see later for details).

Table 1 shows that our operator respondents have greater revenues than the entire universe of farms in the three states. The percentage of owner-operated farms in our sample reporting annual sales greater than $250,000 is over twice that reported in the 2007 Census of Agriculture. The percentage of owner-operators who report that farming is their primary occupation is 56% in our sample, but 43% in the Census universe of farm operators. This is evidence that preservation program selection criteria favor large, commercial operations (see Appendix A for the actual selection criteria used in each program). The main caveat to this finding is that owners who do not operate any of their land are excluded from the preserved farm data in Table 1, while a small group of pure tenant farmers – making up 7% of the total – are included in the Census benchmark group.

All operations, whether farmed by their owners or not, can be compared on the basis of total acreage. Table 2, which includes all farms regardless of tenure status of the operator, shows that the average size of the preserved farms is significantly larger than that of the Census farms in all three states. Although enrolled acreage by ownership unit is not identical to the Census farm size measure, there can be little doubt that the preserved farms in the three states are larger than the universe of all farms in terms of both land area and revenue. This is exactly what the program administrators, with a focus on critical mass and "keystone parcels," intended. Table 2's results also mirror earlier empirical work in Maryland (Lynch and Lovell, 2003) and Delaware (Duke and Ilvento, 2004b).

In our preserved farm sample, 41% of the owners report that they do not operate their land. These owners either leased out the land or hired full-time managers to operate it. It is difficult to compare this 41% figure to data from the Census of Agriculture, because the Census surveys farm operators rather than owners. A comparable metric does exist, however: the count of tenant-operated versus owner-operated acres. This statistic was not published at a sufficient level of detail until the release of the 2012 Census of Agriculture. It is easily computed from our 2010 survey of preserved farms using answers to questions on acreage by type of tenancy.

Table 3 compares the percentage of Census acres operated by tenants to the percentage of preserved farm acres operated by tenants, for all three states. In all cases, the rate of tenancy is lower on farms enrolled in preservation programs than it is in the Census sample. This is especially true for Delaware, which has a relatively high rate of tenancy overall. In the Northeast, small farms that are held for lifestyle purposes are frequently leased out to professional farmers. It should not be surprising, then, that the preserved farms, being relatively large (Table 2), are characterized by less tenancy than the universe of farms in the three study states. The large number of non-operators in the preserved farm sample (41%) are also concentrated on farms that are relatively small (159 acres on average); this leads to a smaller rate of tenancy (28%) when this concept is expressed in terms of acreage rather than ownership units.

We conclude that our preserved farms have larger land area and revenues than the universe of all farm operations in the three states. There is no evidence that lifestyle farmers, retired farmers, or non-operators are disproportionately attracted to farmland preservation programs. According to Table 1, lifestyle farmers are actually under-represented in the preservation cohort relative to all farms, at least when our sample is restricted to the owner-operators for whom we have revenue data. This finding echoes that of Duke and Ilvento (2004b), who found that Delaware program participants were more than twice as likely to be full-time operators than were nonparticipants located outside of the state's agricultural districts.[3]

Expanding the perspective to all landowners and using an acreage measure, we find that landlords who rent their land to others are underrepresented in the preserved farm sample compared to all farms. This difference in rate of tenancy will prove to be important when analyzing patterns of investment, which is the subject of the next section.

Table 3
Percentage of agricultural acres that are owner- versus tenant-operated: Census and preserved farm samples compared.

	Delaware		New Jersey		Maryland		Three states combined	
	2012 Census	Preserved farm sample	2012 Census	Preserved farm sample	2012 Census	Preserved farm sample	2012 Census	Preserved farm sample
% of acres operated by owner	47%	72%	58%	75%	63%	70%	57%	72%
% of acres operated by tenant	53%	28%	42%	25%	37%	30%	43%	28%
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%

Source: 2012 Census of Agriculture, Table 45; Survey responses for preserved farms in the three states reporting some agricultural production.
For comparability with the Census of Agriculture, preserved acres run by salaried managers are considered to be owner-operated.

Table 4
Have you invested in ------ since you first owned this preserved land?

	Irrigation		Buildings		Equipment		Conservation practices	
	Number	%	Number	%	Number	%	Number	%
YES	93	19%	278	57%	321	66%	217	45%
NO	387	80%	201	42%	151	31%	256	53%
[a]	4	1%	5	1%	12	2%	11	2%
	484	100%	484	100%	484	100%	484	100%

[a] Don't know/no response.

Agricultural and conservation investment behavior

Census data on investment behavior are especially difficult to compare to our survey results, because the Census reports only total value of the existing capital stock. In contrast, we asked respondents whether they had engaged in a number of specified investment activities since their parcels were originally preserved. It is necessary to ask the question this way in order to distinguish post-preservation from pre-preservation investment activities.

While farms can be operated without any new investment, recent and continuing investment signals that operators are actively pursuing public objectives like increased production, innovation, land stewardship, and profitability. Government farm programs, including those targeted at income maintenance, tend to discourage passive management; some even require evidence of active farming in order to remain eligible. The so-called "actively engaged" eligibility standard, which was codified in the federal government's Farm Program Payments Integrity Act of 1987, explicitly includes investment as a criterion:

Although state programs that acquire deeds of easement do not replicate this federal requirement exactly, their statutory language reflects its spirit (see Appendix A). The federal standard quoted above justifies our use of the phrase "actively engaged," as well as our focus on part-time versus full-time farming as both a descriptive and an explanatory variable in our sample of preserved farms.

Our questions on investment activity were asked only of preserved farms that reported at least some agricultural production (this is 95.5% of our entire sample). Respondents were asked to respond "yes" to these questions if they or their managers had made the specified type of investment at least once since they owned the preserved land.

The tabulated answers to our investment questions are similar to what we would expect from any sample of agricultural operations, preserved or unpreserved (see Table 4). Close to 70% of the survey respondents report having invested in equipment, which is essential for modern farming and which depreciates relatively quickly. Close to 60% report investing in buildings or other structures, which are generally allowed in the programs' deed restrictions provided that they support agricultural production, e.g., barns, silos, sheds, and fences. Investments in new conservation practices were made by a little less than half of the sample, while only about a fifth of the respondents report investing in irrigation systems. These latter kinds of investments tend to be more discretionary than the first two, while the returns to irrigation investment will vary greatly by location, commodity type, and farm size.

The results reported in Table 4 do not include non-participants. In an earlier study based on a Maryland survey, Lynch (2007) found that 66% of respondents invested in the farm over the last five years, compared to 55% for nonparticipants. In addition, program participants were much more likely than non-participants to attend workshops to learn new technologies and enhance their farming skills. Both of these constitute direct measures of "active engagement."

Description of regression analysis and variables

Regression analysis will allow us to explore the variance in investment behavior across different types of owners and operators within our sample of owners of preserved farms. Information on the dollar magnitude of the investments is not available in the survey. Therefore the dependent variables must be binary: the simple 0 or 1 response to the question "did you invest in _____," for each type of investment.

One could specify a regression model for each type of investment separately. This approach ignores the fact that respondents are likely to behave similarly with respect to all investments; there should be an overall propensity to invest or not invest. A constructed aggregate variable, such as the sum of the four binary investment variables, is an unsatisfying solution to this problem, because investments of all types would implicitly carry the same weight. That particular aggregate variable actually measures diversity, rather than intensity, of investment.[4]

Our solution to this problem is to estimate a multivariate probit model (MVProbit). The MVProbit model generates regression coefficients for each type of investment, while formally incorporating – and providing a hypothesis test for – the expected correlation across errors in the four models that might have been estimated separately. Its only drawbacks are increased standard errors, which are to be expected when formally acknowledging the jointness of the separate investment decisions, and the fact that true marginal effects would need to be estimated for multiple combinations of the dependent variables.[5] These drawbacks did not prove to be fatal to the analysis, and the MVProbit model was successfully employed for all of the analyses presented below.[6]

The independent variables in the analysis may be divided roughly into six groups (see Appendix B for the actual survey questions and descriptive data on the variables described here). First, there is the federal farmer typology. This typology was originally designed to distinguish large commercial farmers from hobbyists and other forms of part-time or 'limited resource' farmers (Hoppe et al., 2000). The metrics behind the federal farmer typology include both total sales and the percentage of annual work hours devoted to farming. Our own categories collapse some of the federal ones, as follows:

Farm occupation, high sales: Respondent spent more than 50% of time as a farmer in 2010 and had more than $250,000 in sales.

Farm occupation, low sales: Respondent spent more than 50% of time as a farmer in 2010 and had less than $250,000 in sales.

Lifestyle farmer: Respondent spent less than 50% of time as a farmer in 2010 or was retired, and had less than $250,000 in sales.

These three categories apply to owner-operators in the sample only. A separate, non-overlapping category consists of owner nonoperators. This fourth group of respondents owned land that was farmed, but because they are not operators they were not asked anything about their annual sales.

Dummy variables were created for three of the four farmer types listed above, with Farm occupation, high sales serving as the omitted category. All of the estimated regression coefficients therefore implicitly compare smaller or less professional farmers (including owners who use tenants or managers to farm their land) to the largest, most hands-on commercial operators in the sample.

The second category of independent variables includes basic control variables like size of farm in acres and the number of years since preservation. Both of these variables are expected to increase the

probability of making investments of all types (James and Hendrickson, 2010; Fernandez-Cornejo and Daberkow, 2002; Lambert et al., 2007), although smaller farms are frequently hypothesized to be more environmentally oriented (Tavernier and Tolomeo, 2004; Welsh and Rivers, 2011).

Demographic variables constitute the third type of covariate. The role played by gender in investment decisions is unclear, but this variable is commonly included in studies of farmer behavior or attitudes (Wilson et al., 2013; Inwood, 2008). Other things equal, farmers with more education are expected to invest more and be more innovative (Inwood, 2008; Fernandez-Cornejo and Daberkow, 2002; Prokopy et al., 2008; Skaggs and Samani, 2005), while older farmers are expected to invest less because of shortened time horizons (Kimhi and Bollman, 1999; Kimhi and Nachieli, 2001; Pietola et al., 2003; Lambert et al., 2007). If a farmer has a succession plan, however, then he or she may invest more, even at an advanced age (Kimhi, 1994; Inwood, 2008). Thus the variable denoting existence of a succession plan should have a positive coefficient in the regression models.

A fourth set of variables captures attributes of the deed restriction. If a respondent sold the development rights personally instead of purchasing them from a prior owner, this could lead to greater investment due to availability of funds. (Indeed, this could be the reason why the respondent sold the rights in the first place.) Another case-specific variable relevant to investment is the respondent's self-reporting of a legal constraint on business activity in the deed of easement. Such a constraint is likely to be associated with less investment, other things equal.

The fifth type of independent variable consists of dummy variables for the five conservation easement programs, with New Jersey's serving as the omitted category. These variables will capture broad differences in growing regions, differential regulations and policy emphases (as shown, for example, in Appendix A), and the latent behavior of program administrators.

Finally, data on agricultural commodities exist only for the operators in the sample. Livestock farmers, for example, are more likely to invest in buildings and less likely to invest in irrigation than other farmers. Past research has shown that livestock farming may suffer from the impermanence syndrome to a greater degree than other types of farming (Lopez et al., 1988; Lynch and Carpenter, 2003), and also that hobby farmers are attracted to this sector (Boyd, 1998; Gillespie and Mishra, 2011; McBride and Mathews, 2011). Irrigation necessarily implies field or high value crops, as well as an operation large enough to make this kind of investment worthwhile (Skaggs and Samani, 2005). Commodity covariates are included only in the regression analyses of the subset of owners who are also operators.

Regression results

Table 5 summarizes the MVProbit regression results for all of the respondents. MVProbit analysis provides a test statistic, p, that can be used to test the hypothesis of correlated behavior among each possible pair of investments. As shown at the bottom of Table 5, rho is statistically significant at the 5% level for two out of six combinations of the four investments, and at the 10% level for two more. These results justify our decision to use MVProbit rather than four separate models.

The most notable finding from Table 5 is that non-operators (i.e., those whose land was farmed by tenants or managers) report fewer instances of investment than operators, no matter how the dependent variable is specified. Although it is possible that our nonoperator respondents are ignorant of certain investments made by tenants on their land – e.g., for equipment – this finding is nevertheless consistent with the prior literature on agricultural investment behavior. Gustafson et al. (1988) identified a positive relationship between being an owner-operator and the purchase of equipment. Clearfield and Osgood's comprehensive literature review from 1986 reported that the adoption of conservation practices was positively associated with farm ownership among operators. Soule (2001) found that renters were less likely than owner-operators to implement two out of ten nutrient and soil management practices.[7] Using mathematical simulation, Myyra et al. (2007) found that irreversible land improvements decline as a result of uncertainty in lease contract renewal.

In contrast to the dominant hypothesis that owner-operators are more engaged stewards because they have a long-term stake in the land, Lambert et al. (2007) found no effect of tenure status on conservation practices in a sample of family farms across the United States. Tavernier and Tolomeo

(2004) found that smaller farms in New Jersey were more likely than larger farms to engage in "sustainable agriculture," but this effect reverses direction when the operator owns more than 75% of the land. The reason given for this result is that owners, with an equity stake in the land, are more likely than tenants to behave in accordance with the impermanence syndrome, rejecting sustainable practices as a waste of money. This logic is irrelevant for preserved farms, however, where the impermanence syndrome is eliminated. Thus, most of the existing literature supports Table 5's finding that owner-operators of preserved farms are more likely to invest in agriculture than their non-operating (possibly absentee) counterparts. Fortunately for the goal of "active engagement" in agriculture, more preserved acres in the three states are owner-operated than is the case for the Census universe of all farms (Table 3).

The other farmer categories that deserve scrutiny on theoretical grounds – lifestyle farmers and professional farmers with low sales – exhibit lower irrigation investment relative to the most commercial benchmark group. These less-professionalized operations, however, are just as likely to invest in soil conservation, equipment, and buildings as are their larger and more professional counterparts.

These results are consistent with those in the existing literature. Inwood (2008) found that hobby farmers scored significantly lower than commercial farmers in their stated desire to be a good steward of land and soil. Yet she found no significant difference among farmer types in past capital investments or future investment plans (p. 277). Fernandez-Cornejo and Daberkow's (2002) study of corn and soybean farms is notable for failing to find a relationship between the federal farmer typology and the adoption of technological innovations, a behavior that is behaviorally similar to capital investment.[8] In an analysis of ten nutrient and soil management practices, Soule (2001) identified lower adoption rates by limited resource and residential lifestyle farmers for conservation tillage only; lower-sale farms were also found to do less crop rotation. These practices do not technically constitute investments, however, and Soule's sample included only corn farms located in America's Corn Belt.

Continuing with the literature on conservation practices, we note that Kristensen (1999) failed to identify significant differences in landscape or land cover between professional and hobby farmer samples. This finding was contradicted by another study completed the same year in the same country (Denmark). That study suggested that hobby farmers sacrificed some agricultural output in pursuit of esthetic changes, pursuing 'extensification' (Primdahl, 1999). In a study that classified farmers by off-farm income, retirement status, education, and tenancy, Lambert et al. (2007) found no effects on conservation behavior for any variable other than education.[9]

Our own findings on the investment and conservation behavior of small and lifestyle farms enrolled in preservation programs, combined with the literature on all farms, should provide comfort to program administrators who want participants to be "actively

Farm size or farm professionalism?

Although Table 5 presents the investment findings in an intuitive way, it has one drawback that stems from its reliance on the federal farm typology. The federal typology was developed using a combination of measures on both occupation and farm size (e.g., a farm with low sales that is run by a part-time operator is classified as "lifestyle.") Because we included farm acreage in our regressions, there is likely to be some collinearity with the farm typology dummies. Note that the average size of the high-sale professional farms in our sample is 468 acres. The non-operator farms, lifestyle farms, and lower-sale professional farms have average sizes of 159, 167, and 151 acres respectively.

Further analysis was conducted to see whether primary occupation or farm size ultimately drives the results reported in Table 5. It will be especially important to see if our conclusion on owner non-operators continues to hold after owner status and operation size are more carefully separated. The results of this additional analysis are shown in Tables 6 and 7.

Table 6 is similar to Table 5, except that the three federal typology dummy variables are replaced by the respondent's answer to a survey question on primary occupation, with 1 = farm operator and 0=other. While this approach does not eliminate potential collinearity caused by the correlation

between full-time farming and farm size (Layton, 1978; Hart, 1992; Inwood, 2008), it does have the benefit of removing size of operation from the "typology" variable. In Table 6, farm size continues to influence irrigation investment as in Table 5, and it achieves borderline significance with respect to conservation investment.[10] More types of investment, however, are affected positively by occupation of the respondent than by having a large farm. Table 6's results are therefore consistent with those of Table 5, which found a consistent negative effect from being a non-operator, but relatively little effect from having a large farm.

Table 5
Multivariate probit analysis of post-preservation investments, all respondents ($n = 429$).

	(1) Conservation			(2) Buildings			(3) Equipment			(4) Irrigation		
Variable	Coef.	Std. err.	$P>z$	Coef.	Std. err.	$P>z$	Coef.	Std. err.	$P>z$	Coef.	Std. err.	$P>z$
Total acres preserved	0.000	0.000	0.160	0.000	0.000	0.529	0.000	0.000	0.697	0.001	0.000	0.010
Sold any rights personally	−0.226	0.160	0.159	0.070	0.163	0.665	−0.128	0.182	0.482	−0.234	0.196	0.232
Full time farmer, low sales	−0.290	0.229	0.205	−0.064	0.244	0.792	0.295	0.309	0.339	−0.681	0.247	0.006
Lifestyle farmer	−0.200	0.226	0.375	−0.286	0.234	0.222	−0.002	0.279	0.995	−0.651	0.244	0.008
Non-operator landowner	−0.484	0.214	0.024	−0.872	0.223	0.000	−1.237	0.256	0.000	−1.051	0.237	0.000
Delaware ALPF program	0.525	0.213	0.014	−0.260	0.216	0.230	−0.145	0.246	0.556	−0.113	0.237	0.634
Maryland ALPF program	0.301	0.159	0.058	0.264	0.163	0.107	−0.259	0.183	0.158	−0.754	0.196	0.000
Maryland environmental trust	0.384	0.225	0.088	0.264	0.226	0.244	−0.225	0.244	0.357	−1.104	0.343	0.001
Maryland rural legacy program	0.288	0.287	0.316	−0.224	0.286	0.433	−0.296	0.313	0.345	−0.438	0.333	0.188
Business restriction	0.027	0.169	0.872	0.253	0.174	0.145	−0.172	0.190	0.364	−0.052	0.191	0.785
Age of respondent	−0.005	0.006	0.383	−0.005	0.006	0.415	−0.011	0.007	0.096	0.004	0.007	0.601
Time since preservation	0.028	0.008	0.001	0.023	0.008	0.006	0.039	0.010	0.000	0.015	0.010	0.125
Succession plan	0.160	0.144	0.267	−0.005	0.146	0.974	0.239	0.158	0.130	0.022	0.174	0.898
Male = 1	0.343	0.137	0.012	0.017	0.138	0.903	0.151	0.151	0.319	−0.241	0.165	0.144
Education	0.026	0.041	0.528	−0.016	0.041	0.693	−0.039	0.046	0.400	0.032	0.048	0.503
Constant	−0.365	0.464	0.431	0.601	0.471	0.202	1.482	0.542	0.006	−0.177	0.543	0.744
Correlations across investments types												
$\rho_{2,1}$	0.194			0.076			0.011					
$\rho_{3,1}$	0.162			0.084			0.053					
$\rho_{4,1}$	0.140			0.090			0.119					
$\rho_{3,2}$	0.358			0.080			0.000					
$\rho_{4,2}$	0.185			0.096			0.055					
$\rho_{4,3}$	0.164			0.104			0.116					

Log likelihood = −894.39511, Wald $chi^2(60) = 233.08$: Prob > $chi^2 = 0.0000$.
Likelihood ratio test of rho21 = rho31 = rho41 = rho32 = rho42 = rho43 = 0: $chi^2(6) = 32.0845$ Prob > $chi^2 = 0.0000$.
Shaded values represent a p-value of less than 5%.

Unlike Table 5, Table 6 does not answer the question of whether non-operators behave differently from operators who are parttime, retired, or simply have low sales. Table 7 provides additional insight into this question. It reports the results of a regression that is identical to Table 6, but with non-operators removed. This table shows that when non-operators are removed, the effect of primary occupation on investment behavior vanishes for all types of investment with the exception of irrigation. Table 5, which used the federal farmer typology to denote farmer type, showed that "non-operator" was the only dummy variable that had a negative effect on three out of four types of investment. Table 7 shows that farmer type (primary occupation in this case) has no effect on the same three investments when non-operators are removed from the sample and the farm size effect is more carefully controlled. It follows that non-operator status – but not part-time farming by those who report themselves to be operators – is the key personal attribute associated with lower investment rates on preserved farms.[11]

Irrigation investments are affected by all measures of farm professionalism and farm size in Tables 6 and 7, just as they were in Table 5. Considering the other three types of investment, Tables 6 and 7 should lessen policy makers' concerns about part-time operators, while focusing their attention on non-operators and absentee owners.

Table 5 also contains some variations in investment behavior across the five farmland preservation programs. There appears to be more conservation investment in the Delaware ALPF program, and less irrigation investment in two of the Maryland programs, than there is in the New Jersey program. Differences in irrigation may be explained by the relatively large number of fruit and vegetable operations in southern New Jersey, many located on sandy soils. Two programs in the Chesapeake region – Maryland Environmental Trust and Delaware ALPF – pay more statutory attention to environmental conservation than New Jersey's program (see Appendix A); in the case of Delaware,

the agricultural land preservation program is administratively co-located with the environmental land preservation program.

Of the remaining variables that are statistically significant in Table 5, we offer no explanation for the apparently greater tendency of male respondents to engage in conservation investments. Before discussing the remaining personal variables, none of which is significant in Table 5, we would point out that inclusion of a large cohort of non-operators in the sample is problematic for these variables. Non-operators do not necessarily plan out all capital investments or think about agricultural aspects of the operation, including the important matter of inter-generational transfer (AELOS, 1999; Constance et al., 1996). Table 8 therefore repeats the analysis of Table 5 – but it omits non-operators, for whom certain operational questions are meaningless. Operators were also the only respondents who answered survey questions on agricultural commodity: these answers are included as covariates in Table 8.

Table 6
Multivariate probit analysis of investments, farm typology variable replaced by principal occupation ($n = 460$).

	(1) Conservation			(2) Buildings			(3) Equipment			(4) Irrigation		
Variable	Coef.	Std. err.	P>z	Coef.	Std. err.	P>z	Coef.	Std. err.	P>z	Coef.	Std. err.	P>z
Total acres preserved	0.000	0.000	0.056	0.000	0.000	0.285	0.000	0.000	0.404	0.001	0.000	0.000
Sold any rights personally	−0.190	0.154	0.216	0.096	0.153	0.531	−0.052	0.160	0.746	−0.197	0.182	0.277
Primary occupation is farmer	0.180	0.138	0.191	0.495	0.139	0.000	0.785	0.154	0.000	0.549	0.153	0.000
Delaware ALPF program	0.484	0.209	0.021	−0.253	0.209	0.226	−0.187	0.220	0.396	−0.074	0.225	0.742
Maryland ALPF program	0.298	0.152	0.050	0.275	0.154	0.074	−0.071	0.163	0.665	−0.772	0.186	0.000
Maryland environmental trust	0.454	0.214	0.034	0.206	0.213	0.334	−0.136	0.217	0.530	−1.003	0.306	0.001
Maryland rural legacy program	0.308	0.279	0.270	−0.045	0.274	0.870	0.135	0.294	0.646	−0.388	0.321	0.226
Business restriction	−0.008	0.162	0.960	0.180	0.163	0.270	−0.155	0.168	0.357	−0.074	0.182	0.684
Age of respondent	−0.010	0.005	0.055	−0.006	0.005	0.251	−0.013	0.006	0.023	−0.004	0.007	0.586
Time since preservation	0.028	0.008	0.000	0.019	0.008	0.017	0.024	0.009	0.005	0.014	0.009	0.127
Succession plan	0.191	0.140	0.173	−0.025	0.139	0.856	0.152	0.143	0.287	0.072	0.168	0.669
Male = 1	0.403	0.130	0.002	0.122	0.129	0.345	0.262	0.134	0.050	−0.119	0.153	0.439
Education	0.002	0.039	0.960	−0.022	0.039	0.563	−0.029	0.041	0.483	0.001	0.045	0.975
Constant	−0.407	0.426	0.340	0.051	0.424	0.905	0.752	0.452	0.096	−0.678	0.499	0.174
Correlations across investments types												
$\rho_{2,1}$	0.167			0.073			0.023					
$\rho_{3,1}$	0.265			0.076			0.000					
$\rho_{4,1}$	0.199			0.087			0.022					
$\rho_{3,2}$	0.414			0.071			0.000					
$\rho_{4,2}$	0.239			0.087			0.006					
$\rho_{4,3}$	0.269			0.092			0.003					

Log likelihood = −1004.0375, Wald $chi^2(52) = 170.78$: Prob > $chi^2 = 0.0000$.
Likelihood ratio test of rho21 = rho31 = rho41 = rho32 = rho42 = rho43 = 0: $chi^2(6) = 53.3787$ Prob > $chi^2 = 0.0000$.
Shaded values represent a p-value of less than 5%.

Table 7
Multivariate probit analysis of investments, farm typology variable replaced by principal occupation, operators only ($n = 287$).

	(1) Conservation			(2) Buildings			(3) Equipment			(4) Irrigation		
Variable	Coef.	Std. err.	P>z	Coef.	Std. err.	P>z	Coef.	Std. err.	P>z	Coef.	Std. err.	P>z
Total acres preserved	0.000	0.000	0.203	0.000	0.000	0.855	0.000	0.000	0.307	0.001	0.000	0.009
Sold any rights personally	−0.167	0.202	0.408	−0.021	0.205	0.917	0.029	0.244	0.904	−0.142	0.217	0.513
Primary occupation is farmer	−0.030	0.172	0.862	0.237	0.174	0.172	0.333	0.206	0.105	0.388	0.188	0.039
Delaware ALPF program	0.715	0.283	0.012	0.107	0.288	0.711	0.937	0.583	0.108	0.092	0.279	0.741
Maryland ALPF program	0.368	0.186	0.049	0.128	0.194	0.509	−0.236	0.225	0.294	−0.796	0.213	0.000
Maryland environmental trust	0.501	0.318	0.115	0.067	0.321	0.834	−0.207	0.366	0.572	−1.096	0.420	0.009
Maryland rural legacy program	0.356	0.327	0.277	−0.257	0.324	0.428	−0.323	0.354	0.361	−0.531	0.368	0.150
Business restriction	−0.048	0.203	0.812	0.189	0.212	0.373	0.050	0.252	0.842	−0.097	0.219	0.658
Age of respondent	−0.015	0.007	0.038	−0.006	0.007	0.426	−0.016	0.009	0.063	−0.007	0.008	0.344
Time since preservation	0.025	0.010	0.016	0.029	0.011	0.007	0.027	0.013	0.040	0.014	0.011	0.189
Succession plan	0.619	0.185	0.001	0.031	0.183	0.863	0.332	0.207	0.109	0.211	0.205	0.304
Male = 1	0.455	0.177	0.010	−0.036	0.177	0.841	0.204	0.204	0.318	−0.033	0.193	0.863
Education	−0.003	0.051	0.957	−0.007	0.052	0.886	−0.014	0.062	0.825	0.010	0.055	0.863
Constant	−0.307	0.540	0.570	0.389	0.541	0.471	1.380	0.656	0.035	−0.446	0.581	0.443
Correlations across investments types												
$\rho_{2,1}$	0.115			0.097			0.233					
$\rho_{3,1}$	0.197			0.111			0.077					
$\rho_{4,1}$	0.184			0.102			0.071					
$\rho_{3,2}$	0.377			0.109			0.001					
$\rho_{4,2}$	0.218			0.108			0.042					
$\rho_{4,3}$	0.071			0.124			0.565					

Log likelihood = −588.78137, Wald $chi^2(52) = 104.43$: Prob > $chi^2 = 0.0000$.
Likelihood ratio test of rho21 = rho31 = rho41 = rho32 = rho42 = rho43 = 0: $chi^2(6) = 20.6018$ Prob > $chi^2 = 0.0022$.
Shaded values represent a p-value of less than 5%.

Because Table 8 omits non-operators entirely, the farmer typology variables tend to lack significance. This mirrors the findings in Tables 5–7 indicating that non-operator status, rather than part-time farming or farm size, is the key concern. In contrast to Table 5, Table 8 shows that older operators are less likely to invest in equipment than younger operators. If operators have a succession plan, however, then they are more likely to invest in conservation. These results confirm past research regarding the investment behavior of older farmers and of those who have thought about passing the farm on to their offspring (Kimhi, 1994). In addition, the fact that the existence of a succession plan is correlated with conservation investment may indicate a characteristic of forward-looking thinking that embraces both environmental and family or businessrelated goals simultaneously (see Inwood, 2008; Lynch and Lovell, 2003).

In contrast to age, education level does not suddenly become statistically significant in the operators-only model. Northeastern preservation program participants, however, are better educated than the samples of farmers examined in prior studies. About 49% of our sample of operators report holding a bachelors' degree or higher. The same figure for farmers throughout the U.S. was 21.3% in 2011, according to the Bureau of Labor Statistics (BLS, 2011). The very different range of this independent variable yields a different result than in prior work. Education level has no effect on investment behavior, holding other things equal.

The relatively high education level of farmers in our sample, like the relatively large size of their farms, could actually be offsetting negative expectations on investment behavior for a preserved farm sample. We have not formally investigated whether the education levels observed here are a product of the Northeast, which is characterized by high levels of education in general, or by a correlation between education and participation in preservation programs. Note that in a study of a different sample of operations, Lynch and Lovell (2003) found little difference in the education of participants and nonparticipants in farmland preservation programs.

Table 8 shows that among operators, the keeping of livestock is understandably associated with more investment in farm buildings and less investment in irrigation. The amount of time that has passed since the easement was sold is significantly positive in all models, as we would expect given the way the investment questions are worded. These are all common-sense control variables for agricultural investment behavior.

Table 8
Multivariate probit analysis of post-preservation investments, operators only ($n = 256$).

	(1) Conservation			(2) Buildings			(3) Equipment			(4) Irrigation		
Variable	Coef.	Std. err.	$P>z$	Coef.	Std. err.	$P>z$	Coef.	Std. err.	$P>z$	Coef.	Std. err.	$P>z$
Total acres preserved	0.000	0.000	0.394	0.000	0.000	0.913	0.000	0.000	0.283	0.000	0.000	0.134
Keep livestock	−0.101	0.177	0.568	0.507	0.184	0.006	0.429	0.230	0.063	−0.638	0.200	0.001
Raise crops	0.004	0.350	0.992	0.077	0.358	0.830	−0.626	0.485	0.196	0.546	0.467	0.242
Sold any rights personally	−0.281	0.218	0.197	−0.017	0.231	0.942	−0.099	0.308	0.748	−0.346	0.250	0.166
Full time farmer, low sales	−0.264	0.236	0.264	−0.107	0.254	0.673	0.316	0.341	0.354	−0.715	0.260	0.006
Lifestyle farmer	−0.183	0.239	0.444	−0.315	0.249	0.207	−0.092	0.318	0.772	−0.633	0.255	0.013
Delaware ALPF program	0.789	0.295	0.008	0.112	0.299	0.707	0.956	0.622	0.124	−0.054	0.300	0.856
Maryland ALPF program	0.400	0.201	0.047	0.033	0.215	0.877	−0.497	0.270	0.066	−0.709	0.235	0.003
Maryland environmental trust	0.275	0.359	0.443	0.113	0.372	0.762	−0.599	0.457	0.190	−1.519	0.588	0.010
Maryland rural legacy program	0.377	0.338	0.265	−0.413	0.349	0.236	−0.688	0.383	0.073	−0.558	0.386	0.149
Business restriction	0.016	0.217	0.942	0.272	0.236	0.248	−0.022	0.294	0.940	0.013	0.241	0.958
Age of respondent	−0.007	0.008	0.392	−0.010	0.008	0.222	−0.027	0.011	0.016	0.006	0.009	0.506
Time since preservation	0.023	0.011	0.036	0.039	0.012	0.001	0.046	0.017	0.006	0.012	0.012	0.338
Succession plan	0.550	0.192	0.004	−0.016	0.196	0.934	0.408	0.236	0.084	0.110	0.221	0.618
Male = 1	0.377	0.193	0.050	−0.048	0.202	0.813	0.099	0.251	0.693	−0.337	0.220	0.126
Education	0.039	0.055	0.476	0.034	0.058	0.553	0.015	0.073	0.834	0.058	0.063	0.358
Constant	−0.525	0.744	0.481	0.432	0.769	0.574	2.571	1.040	0.013	−0.440	0.881	0.617

Correlations across investments types

$\rho_{2,1}$	0.086	0.104	0.406
$\rho_{3,1}$	0.080	0.123	0.513
$\rho_{4,1}$	0.070	0.120	0.562
$\rho_{3,2}$	0.306	0.135	0.024
$\rho_{4,2}$	0.297	0.115	0.010
$\rho_{4,3}$	0.061	0.146	0.676

Log likelihood = −492.55105, Wald $chi^2(64) = 126.52$: Prob > $chi^2 = 0.0000$.
Likelihood ratio test of rho21 = rho31 = rho41 = rho32 = rho42 = rho43 = 0: $chi^2(6) = 11.901$ Prob > $chi^2 = 0.0642$.
Shaded values represent a p-value of less than 5%.

The variables "sold rights personally" and "business restriction" lack statistical significance in all of the investment models estimated for this study. Thus there is no clear evidence that the net effect of cash from easement sales leads to either greater investment, or less investment – as might be the case if the sale of an easement signaled a desire to retire (see, e.g., the results on partial land sales and planning horizon reported in Adelaja et al., 2011). Nor does the reported existence of a business restriction in the easement lead to less investment, as hypothesized. Our conclusion is that policy makers need not be concerned about the effects of these two case-specific factors on active engagement in agriculture after farmland preservation.

Conclusion

A number of studies have started with the premise that hobby farms are destructive to peri-urban commercial agriculture, either because they are not "actively engaged" (Layton, 1978; Blank, 2005; Hart, 1992; Ceddia et al., 2009) or because they fragment rural landscapes that previously enjoyed spatial critical mass (Layton, 1978; Daniels, 1986; Stobbe et al., 2009). While hobby farms are clearly smaller than their more commercial counterparts, small farms are the norm in states like New Jersey, Delaware, and Maryland (Table 2). A cause and effect relationship running from hobby farming to significant rural fragmentation has yet to be established in these states. (Note that this is a different causal question than the fragmenting effect of uncoordinated easement purchases by states, local governments, and nonprofit organizations.) Meanwhile, most North American empirical studies comparing lifestyle farms to commercial farms have failed to find anticipated differences in measures of "active engagement" in agriculture or conservation. Thus, fears about the deleterious effect of hobby farming on fringe agriculture voiced by authors like Daniels (1986) may be exaggerated, at least for the Northeast.

The present study has extended this literature on behavior by farmer type to the special subset of farms that have already been preserved. Because active engagement in agriculture is not strictly required on these farms, policy makers fear that preservation programs could consist of operators mainly interested in scenic vistas rather than agricultural production or soil conservation. Judging by our survey responses to questions on agricultural and conservation-related investments, however, this does not seem to be the case (Table 4). A likely reason for this observed outcome is that our five preservation programs have been successful at selecting larger and more commercial farms than those in the general population (Tables 1 and 2). A second, but more difficult to prove reason could be the fact that the impermanence syndrome driven by imminent development is removed for this special sample of farms.

A second comforting finding is that smaller and lifestyle preserved farmers do not invest significantly less in agriculture or conservation than the more commercial benchmark group, irrigation being a notable exception to this rule.

We did identify significantly less investment by non-operating owners across all investment types (Table 5). Before sounding the alarm bell on this finding, we would make four points: (1) measured by acres, tenancy is less common in the preserved farm sample than in the Census universe of farms in the three study states; (2) because we surveyed landowners rather than operators, certain types of investment (e.g., equipment) may be under-reported; (3) less active engagement by non-operating owners or tenants is reported in the prior literature, so it is not unique to a preserved farm cohort; (4) fewer studies in the literature explore the behavioral effects of tenure than of variables like sales, size, or primary occupation.

Indeed, it is not clear that the literature on the effects of tenancy and absenteeism is yet large enough to provide a clear comparison to the present study's findings. The use of tenure as a category for policy making is also relatively rare. In a 2007 case study on watershed management in Ohio, Parker, Moore, and Weaver "introduce" the use of land tenure as a criterion for furthering land conservation goals. A 2008 review on the adoption of best management practices identified tenure as an area requiring more research (Prokopy et al., 2008). Writing recently in this journal, Petrzelka et al. (2013) surveyed both the scholarly and policy literatures with a goal of measuring the level of attention paid to "absentee landowner issues in conservation management." They concluded that

the definition of this class of landowners is not sufficiently standardized for research purposes[12]; that studies on absentee owners of farmland are "extremely limited"; and that "little formal policy or program [sic] at the state or federal level was identified as having any direct or explicit emphasis on landownership issues . . ." Given our own findings, tenancy and absentee ownership remain important topics for additional research on preserved farms and their post-preservation performance.

From a research point of view, the present study provides a comprehensive set of hypotheses for what one might expect when comparing investment behavior across samples of preserved and unpreserved farms (see Section "Theoretical predictions" above). It presents the first descriptive and regression results for investment behavior in a sample of preserved farms, drawn from a U.S. region characterized by high levels of lifestyle farming and value-added agriculture.

Viewed as a program evaluation, this study provides some interesting contrasts with other studies in that category. In other evaluation studies, such as those on employment training, the existence of self-selection behavior could eliminate the program's efficacy and rationale. In the case of farmland preservation, although program participants may have longer time horizons in agriculture than nonparticipants, those horizons are neither infinite nor unalterable. Program participants could, in theory, have a taste for real estate development at some point in the future. Conservation easements ostensibly bind landowner behavior 'forever.' Therefore, the objective of long-term agricultural preservation in locations having prime soils is achieved by these programs regardless of selection effects.

In this type of program evaluation, then, it becomes less important to implement the complex statistical techniques needed to isolate treatment effects. Simple ex post comparisons will provide valuable guidance to policy makers. That enterprise, begun here, should be continued through the careful matching of administrative records on preserved and unpreserved farms (as in Schilling et al., 2014), or by new, comprehensive surveys of both types of farms that consistently measure stewardship and investment activities, farm attributes, demographic variables, and of course, land tenure.

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Appendix A. Program summaries and goals

Delaware Agricultural Land Preservation Foundation (DALPF)

The Foundation preserves historic structures, wildlife habitats, important environmental features, wetlands, and forests, as well as setting aside, permanently, the critical farmland for future generations of Delawareans.

Number of easements acquired: 716 (AFT, 2013)
Primary method of preservation: Landowners agree to not develop their lands for at least 10 years, devoting the land only to agriculture and related uses, create an Agriculture Preservation District containing at least 200 contiguous acres.
Number of preserved acres: 107,754 (AFT, 2013)
Percentage of agricultural acres in the state that are preserved: 21.2% (based on the land in farms reported in the 2012 Census of Agriculture).
Statutory goals: The Delaware Agricultural Lands Preservation Program was formed with the adoption of House Bill 200 in July, 1991 and strives to "preserve a critical mass of crop land, forest land, and open space to sustain Delaware's number one industry and quality of life, and providing landowners an opportunity to preserve their land in the face of increasing development pressures and decreasing commodity values." (3 Del.C. Section 904(a)(13).)
Minimum eligibility criteria communicated to applicants: Must be a resident of the State of Delaware and have at least three (3) years of farming experience; must have a net worth of no more than $300,000; owner or owners shall hold fee simple title to such property; property shall have an agricultural

zoning designation and shall not be subject to any major subdivision plan; property shall consist of viable and productive farmlands and/or forestlands which meet the minimum LESA scoring requirements for eligibility established by the Foundation through adopted regulations (3 Del. Code Sections 942:948).
Administrative selection criteria in addition to those listed above: High quality soils; Agricultural infrastructure; Historical and environmental significance; Farm size; Proximity of other preserved farms; Commitment to remain actively engaged in the agricultural usage of the farmland; Potential for District expansion with surrounding land uses; Socio-economic benefits derived from an agricultural and historic perspective; and Consistency with the statewide agricultural lands preservation strategy (3 Del. Code Sections 942:948).

Maryland Agricultural Land Preservation Foundation

This is one of the first programs created in the United States and has become one of the nation's leaders in agricultural land preservation. Combining the Foundation's program with county and other State land preservation programs, Maryland has preserved more agricultural land for future production than any other state in the Union.

Number of easements acquired: 2099 (AFT, 2013) Primary method of preservation: Purchase of perpetual agricultural conservation easements to prevent farmland from being developed for residential, commercial or industrial uses. Number of preserved acres: 285,701 (AFT, 2013) Percentage of agricultural acres in the state that are preserved: 14.1% (based on the land in farms reported in the 2012 Census of Agriculture).
Statutory goals: The Maryland General Assembly passed a resolution in 2002 that established a statewide goal of preserving 1,030,000 acres of productive farmland by 2020, roughly the amount of land necessary to "support a reasonable diversity of agricultural production" throughout the state. The state goals for agricultural land preservation are "to preserve productive farmland and woodland for the continued production of food and fiber for all of Maryland's citizens; curb the expansion of random urban development; help curb the spread of urban blight and deterioration and protect agricultural land and woodland as open space." (Annotated Code of Maryland, Sections 2-501–2-515).
Minimum eligibility criteria communicated to applicants: Participating properties must be at least 50 acres in size (or be contiguous to properties already under easement); contain at least 50 percent qualifying soils; If the land is wooded, 50 percent of the land must meet woodland soils criteria. Land is generally not eligible if it is in a planned development area (Agricultural Article, Sections 2-515–2-516).
Administrative selection criteria in addition to those listed above: Farm size; Productivity; Location; Conservation and Management Plans; Commitment to not change the conditions of the property (Agricultural Article, Sections 2-515–2-516).

Maryland Environmental Trust

MET serves as the model statewide land trust and is a recognized national and state leader in private land conservation. It is one of the oldest and most successful land trusts in the country and most cost-effective land preservation program available in the state, since donated easements cost a fraction of the cost of purchased easement programs.

Number of easements acquired: 1070 (MET program website) Primary method of preservation: Donated conservation easements ensuring that a property shall not be developed (or subdivided) beyond a limit agreed upon by both parties. Number of preserved acres: 130,000 (MET program website) Percentage of agricultural acres in the state that are preserved: N/A (not all eased land is farmland)
Statutory goals: The purpose of MET as set out in the governing statute is "to conserve, improve, stimulate, and perpetuate the esthetic, natural, health and welfare, scenic, and cultural qualities of the environment, including, but not limited to land, water, air, wildlife, scenic qualities, open spaces, buildings or any interest therein." "Through educational and other means, the Trust shall encourage

and motivate the populace of the State and others to do so and shall promote continuing interest in and the study of these matters." (Section 2-118, Real Property)
Minimum eligibility criteria communicated to applicants: Properties must have agricultural, environmental, or historical conservation value; no legal minimum size: 20 acres waterfront or 50 acres inland preferred; property is contiguous to existing properties protected by their fee or conservation easement ownership, or closely clustered with other protected parcels that make up a larger preservation area; the conservation easement would provide public access (Annotated Code of Maryland, 3-201).
Administrative selection criteria in addition to those listed above: Cropland; Pastureland; Woodland; Undisturbed open space; Ecologically significant areas; scenic landscapes or features; historic sites and other significant or unique features (Annotated Code of Maryland, 3-201).

Maryland Rural Legacy Program

The program is focused on a community-up approach to land preservation, stressing partnerships among federal, state, and local governments and non-profit land trusts. Under the program, counties apply to designate parcels as Rural Legacy Areas. After state approval, the counties apply annually for state funds to help with land preservation in the Rural Legacy Area.

Number of easements acquired: 532 (AFT, 2013)
Primary method of preservation: The acquisition of easements and fee estates from willing landowners and the supporting activities of Rural Legacy Sponsors and local governments.
Number of preserved acres: 76,146 (AFT, 2013)
Percentage of agricultural acres in the state that are preserved: 3.7% (based on the land in farms reported in the 2012 Census of Agriculture).
Statutory goals: The program was enacted by the 1997 Maryland General Assembly and strives to "establish greenbelts of forests and farms around rural communities in order to preserve their cultural heritage and sense of place, preserve critical habitat for native plant and wildlife species, support natural resource economies such as farming, forestry, tourism and outdoor recreation, and to protect riparian forests, wetlands, and greenways to buffer the Chesapeake Bay and its tributaries from pollution run-off." (Maryland Rural Legacy Program 2002).
Minimum eligibility criteria communicated to applicants: Must be located within a local Rural Legacy Areas; must be 50 + acres unless adjoining a property already under a permanent easement; must have qualifying soils and development rights; economic value of the resource-based industries or services proposed for protection through land conservation, such as agriculture, forestry, tourism and recreation (Natural Resources Article, Section 5-9A03, Annotated Code of Maryland). Administrative selection criteria in addition to those listed above: Size of the protected area and the quality and value of protected resources; Degree of threat to the resources; Availability of a variety of tools to accomplish conservation; Strength of public and private partnerships and support of land use mechanisms (Natural Resources Article, Section 5-9A-03, Annotated Code of Maryland).

New Jersey Farmland Preservation Program
This is the largest easement purchase program in the country in terms of dollars expended and the proportion of the state's agricultural land preserved. This record-setting performance is due largely to the high cost of land, as well as a sense of urgency among voters living in a rapidly urbanizing state that has a rich agricultural heritage.

Number of easements acquired: 2143 (AFT, 2013) Primary method of preservation: Purchase of development rights using funds made available through the Garden State Preservation Trust bond issues.
Number of preserved acres: 201,146 (AFT, 2013)
Percentage of agricultural acres in the state that are preserved: 28.1% (based on the land in farms reported in the 2012 Census of Agriculture)
Statutory goals: The preamble to the New Jersey Agriculture Retention and Development Act of 1983 states that "strengthening of the agricultural industry and the preservation of farmland are impor-

tant to the present and future economy of the State and the welfare of the citizens of the State" and that "all state departments and agencies thereof should encourage the maintenance of agricultural production and a positive agricultural business climate." The founding statute adds that farmland preservation should take place "within identified areas where agriculture will be presumed the first priority use of the land" (N.J. Rev. Stat. Section 4:1C-12). Thus the New Jersey farmland preservation program has an agricultural production (use) objective, not merely a land preservation objective.
Minimum eligibility criteria communicated to applicants: Must be in a state-certified agricultural development area; current agricultural sales above a threshold ($2500 annually for smaller parcels); minimum percentage of land must be tillable; soil suitable for agriculture; land must currently have development potential (SADC, 2011a). After deed restriction, a conservation plan must be filed with the local soil conservation district (SADC, 2011b).
Administrative selection criteria in addition to those listed above: Farm size; Percentage of parcel boundary abutting rural or agricultural buffers; Proximity of other preserved farms; Commitment of local community to program objectives; Imminence of development; Likely adverse impacts of development (N.J.A.C. 2: 76-6.16).

AppendixB. Surveyquestionsusedforindependent variables, with frequency counts/means[13]

Respondents by preservation program (not self-reported):

DALPF	12.1%
MALPF	30.8%
MET	12.6%
MRLP	5.4%
NJFPP	39.1%

Q3. [If owned preserved farmland land at end of 2010 whose development rights {DRs} had been sold] At the end of 2010, did you own any agricultural land in [state] whose development rights you, personally, had sold to a farmland preservation program?

1. Yes	73%
5. No	27%

Total acres preserved by four different pathways, regardless of whether owner is an operator.
Mean = 206.5 acres.

Q15. [If Q1a = 1: R owned preserved farmland at end of 2010 whose DRs had been sold.]
The written agreements for selling or donating development rights are often called conservation easements [in Maryland and Delaware; "development easements" in New Jersey]. Those easements usually do not require that the land be farmed, only that it remains available for farming. In 2010 was any of your preserved land in [state] used for raising crops, livestock, nursery products, forest products, or other agricultural goods?

1. Yes	95.5%
5. No	4.5%

Q17. [If Q15 = 1: At least some of the preserved land was used for agricultural production.] In 2010 were you the operator of any farmland in [state] in the sense that you made the day-to-day decisions about such things as planting, harvesting, feeding live- stock, and marketing? You may have rented land to others on a cash or share basis. But did you also farm any land (preserved or unpreserved), yourself?

1. Yes	58.9%
5. No	41.1%

Q21. [If Q17 = 1: R was a farm operator, whether of preserved and/or unpreserved land.] What was the total size of your 2010 operation? Please include preserved and unpreserved land, as well as land that you owned and any land you rented into your operation. Mean = 466.9 acres

Q30. [If Q18 = > 1: R operated in 2010 at least some of his/her preserved farmland.] During 2010 did you produce any crops on your operation in [state], like field crops, orchard crops, or other types of crops including pasture?

1. Yes	92.4%
5. No	7.6%

Q33. [If Q18 = > 1: R operated in 2010 at least some of his/her preserved farmland.] Did you raise any livestock, including horses, on your farm operation in [state] during 2010?

1. Yes	57.4%
5. No	42.3%
[8. Don't know]	.3%

Q91. [Q1a = 1: R owned preserved farmland in 2011.] Next I need to ask about your experiences with restrictions stated in the land conservation easements ["development easements" for New Jersey]. Is there any business or other activity that you would like to undertake on your preserved land, but the easement agreement prevents you from doing it?

1. Yes	18%
5. No	81%
[8. Don't know]	1%

Age of respondent = 2010 minus reported birth year:

20–29	.8%
30–39	2.1%
40–49	9.6%
50–59	31.5%
60–69	27.5%
Over 70	28.5%

Q118. What is the highest level of education you have completed?

		All respondents	Operators only
1.	Grade school	2.5%	2.0%
2.	Graduated high school	36.2%	37.5%
4.	Completed technical or vocational school	3.8%	3.7%
5.	Got an associate's college degree	7.8%	8.1%
7.	A bachelor's college degree	28.0%	28.0%
8.	A graduate degree	21.8%	20.6%

Q120. [Ask of all respondents.] What was your primary occupa- tion in 2010, that is, the occupation on which you spent 50 percent or more of your work time in 2010?

1. Farm operator	34.7%
2. Another occupation	37.2%
3. Retired	28.0%

Q126. [If Q17 = 1: R was a farm operator in 2010.] In 2010 what were the approximate total cash receipts from your farm operation? That total should include gross sales of farm products (that is before expenses are deducted) and any other cash receipts like rents for land or hunting rights, any income from farm-related businesses conducted on your land, and any government payments. Were the total cash receipts:

1. Less than $10,000	25.8%
2. From $10,000 to less than $100,000	33.7%
3. From $100,000 to less than $250,000	16.9%
4. From $250,000 to less than $500,000	7.5%
5. $500,000 or more	16.1%

Notes

1. In contrast to most European countries, the U.S. federal government pays little attention to farmland preservation, largely because farmland is not regarded as especially scarce at the national level (Fischel, 1982; Tweeten, 1998; Eitel, 2003). The Farm and Ranch Lands Protection Program of the Natural Resources Conservation Service (Eitel, 2003) does provide some funding to programs run by states or substate agencies. States take the lead, however, and being as large as some European countries, they are proper units for inter-continental comparison.
2. See also Towe et al. (2008), who found that merely having the option to put a farm into preservation may delay development.
3. None of the statements in this paragraph characterizing preserved farm operators involve any statistical controls for operation size, which is a predictor of professionalization. In Delaware, conservation easement enrollees are a subset of those enrolled in the state's Agricultural District program, which provides right-to-farm protection to operators in designated agricultural areas. Operators located in agricultural districts but without deed restrictions are just as likely to be full-time operators as those who have sold their easements, according to Duke and Ilvento. The authors' comparison, then, provides evidence for a correlation between professionalization and participation in two closely-related programs

designed to protect agriculture from urbanization. It is not about easement purchase programs specifically.

4. A second Boolean variable that can be constructed using the binary investment data, namely "investment A = 1 or investment B = 1 or investment C = 1 or investment D = 1," would not exhibit enough variation for modeling. The vast majority of observations would have a value of 1.
5. Marginal effects are not reported here. In our MVProbit research design, these effects would necessarily be calculated for sixteen different combinations of the four dependent variables, coded 0 or 1. We have no hypotheses or a priori expectations with respect to any of these combinations, as opposed to individual (but correlated) investments, or proxies of overall investment propensity.
6. We are grateful to two anonymous referees for identifying difficulties with various constructed variables of aggregate investment behavior, and for recommending MVProbit as an alternative approach to these correlated investment decisions.
7. Share renters, however, were more likely to implement rotation with legumes, coefficient significant at the 10% level.
8. In the Fernandez-Conejo study, only one of four innovations was found to be significantly less common for only one type of farmer – the very weak "limited resource" group within the federal typology.
9. Part-time farmers were found to prefer conservation techniques that were less 'management intensive,' but this result came from the study's descriptive data tables – not from the ordered probit regression results that controlled for farm size.
10. This result is not too surprising. Irrigation investments benefit from economies of scale and require large parcels to be economic. The same tends to be true of certain soil conservation investments (Clearfield and Osgood, 1986). Equipment investments probably rank next in the extent to which they are proportionate to parcel size, and building investments last. It should be remembered, however, that our investment variables are structured as yes/no answers to questions about incremental additions to a farm's capital stock. The size of the stock itself, as well as the division between that which is logically fixed and that which varies with land area, would best be addressed using a total value of capital measure like that reported in the Census of Agriculture.
11. Recall that "full-time farmer" and "operator" are not synonyms, since many operators (e.g., all of those in the retired and lifestyle categories) report that farming is not their primary occupation. For that matter, more than six percent of the non-operators in our sample report that farming is their primary occupation. These respondents operate land other than the preserved parcels that our survey asked them about.
12. They note that "absentee" is subject to various definitions based on degrees of proximity between residence and operation, although it clearly overlaps with the owner non-operator classification used in the present study.
13. In order to correspond to data used in the regression analyses of investment behavior, these statistics are generally restricted to the 95.5% of respondents who reported some agricultural production on their preserved land (see Q15).

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